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(*Continued on page* 155).

THE BRITISH ASSOCIATION, 1876.

The meeting of the Association was opened on Wednesday, September the 6th, by the presidential address of Professor Thomas Andrews, LL.D., F.R.S., of Belfast, which was, as a practical exposition of the state of science, fully equal to any former address; but as compared with some of those of recent years, does not possess that *ad captandum* force which people now look for in these utterances.

The President's address is not, however, the only address given at the British Association, for each President of the Sections gives one, and this year there have been at least two as attractive and instructive as any ever delivered by any President of the Association or former Section-President. These are the addresses of Sir William Thompson (Physical Science) and Sir George Campbell (Economic Science and Statistics). The former of these is specially noteworthy for some very pertinent remarks on the subject of the Patent Laws, which we have italicised :—

Dr. Andrews, the president, after referring to the splendid scientific memories connected with the city in which he spoke, proceeded to review the progress made during recent years in the various departments of research to which the British Association devotes its attention. The President then considered the actual condition of scientific inquiry in Great Britain and Ireland, and warmly advocated the cultivation of the physical and natural sciences in their widest sense at every complete University, suggesting as an important stimulus the demand from the candidates for some of the higher degrees of proof of original power of investigation. Dr. Andrews concluded his able and most interesting address as follows :—" Whatever be the result of our efforts to advance science and industry, it requires no gift of prophecy to declare that the boundless resources which the supreme Author and Upholder of the universe has provided for the use of man will, as time rolls on, be more and more fully applied to the improvement of the physical and, through the improvement of the physical, to the elevation of the moral condition of the human family. Unless, however, the history of the future of our race be wholly at variance with the history of the past, the progress of mankind will be marked by alternate periods of activity and repose; nor will it be the work of any one nation or of any one race. To the erection of the edifice of civilized life, as it now exists, all the higher races of the world have contributed; and if the balance were accurately struck, the claims of Asia for her portion of the work would be immense, and those of Northern Africa not insignificant. Steam-power has of late years produced greater changes than probably ever occurred before in so short a time. But the resources of nature are not confined to steam, nor to the combustion of coal. The steady water-wheel and the rapid turbine are more perfect machines than the stationary steam-engine; and glacier-fed rivers with natural reservoirs, if fully turned to account, would supply an unlimited and nearly constant source of power depending solely for its continuance upon solar heat. But no immediate dislocation of industry is to be feared, although the turbine is already at work on the Rhine and the Rhone. In the struggle to maintain their high position in science and its applications, the countrymen of Newton and Watt will have no ground for alarm so long as they hold fast to their old traditions, and remember that the greatest nations have fallen when they relaxed in those habits of intelligent and steady industry upon which all permanent success depends."

Physical Science.—The proceedings in this section commenced at 11 o'clock, when its President (Professor Sir William Thompson) delivered the opening address, of which the following is an abridgement :—

A conversation which I had with Professor Newcomb one evening last June in Professor Henry's drawing room in the Smithsonian Institute, Washington, has forced me to give all my spare thoughts ever since to Hopkin's problem of precession and nutation, assuming the earth a rigid spheroidal shell filled with liquid. Six weeks ago, when I landed in England after a most interesting trip to America and back, and I became painfully conscious that I must have the honour to address you here today, I wished to write an address of which science in America should be the subject. I came home, indeed, vividly impressed with much that I had seen both in the Great Exhibition of Philadelphia and out of it, showing the truest scientific spirit and devotion, the originality, the inventiveness, the patient, persevering thoroughness of work, the appreciativeness, and the generous open-mindedness and sympathy from which the great things of science come.

" Θελω λεγειν Ατρειδας
Θελω δε Καδμου αδειν."

I wish I could speak to you of the veteran Henry, generous rival of Faraday in electric-magnetic discovery; of Pierce, the founder of high mathematics in America; of Bache, and of the splendid heritage he has left to America and to the world in the United States' Coast Survey; of the great school of astronomers which followed—Newton, Newcomb, Watson, Young, Alvan Clarke, Rutherford, Draper, father and son; of Commander Belknap and his great exploration of the Pacific depths by pianoforte wire with imperfect apparatus supplied from Glasgow, out of which he forced a success in his own way; and of Captain Sigsbee, who followed with like fervour and resolution, and made further improvements in the apparatas by which he has done marvels of easy, quick, and sure deep-sea sounding in his little surveying ship Blake; and of the admirable official spirit which makes such men and such doings possible in the United States Naval Service. I would like to tell you, too, of my reasons for confidently expecting that American hydrography will soon supply the data from tidal observations, long ago asked of our own Government in vain by a committee of the British Association, by which the amount of the earth's elastic yielding to the distorting influence of sun and moon will be measured; and of my strong hope that the Compass Department of the American Navy will repay the debt to France, England, and Germany, so appreciatively acknowledged in their reprint of the works of Poisson, Airy, Archibald Smith, Evans, and the Liverpool Compass Committee, by giving in return a fresh marine survey of terrestrial magnetism to supply the navigator with data for correcting his compass without sights of sun or stars. I should tell you, also, of "Old Prob's" weather warnings, which cost the nation 250,000 dols. a year, money well spent say the Western farmers, and not they alone; in this the whole people of the United States are agreed, and though Democrats or Republicans playing the "economical ticket" may for half a Session stop the appropriations for even the United States Coast Survey, no one would for a moment think of starving "Old Prob;" and now that 80 per cent. of his probabilities have proved true, and General Myers has for a month back ceased to call his daily forecasts "probabilities," and has begun to call them indications, what will the Western farmers call him this time next year? The United States Naval Observatory is full of the very highest science under the command of Admiral Davis. If to get on to precession and nutation, I had resolved to omit telling you that I had there, in an instrument for measuring photographs of the Transit of Venus shown me by Professor Harkness (a young Scotchman attracted into the United States' Naval Service) seen, for the first time in an astronomical instrument, a geometrical slide,—the verdict on the disaster on board the Thunderer, published while I am writing this address, forbids me to keep any such resolution and compels me to put the question—is there in the British Navy, or in a British steamer, or in a British land boiler another safety-valve so constructed that by any possibility, at any temperature, or under any stress it can jam? and to say that if there is, it must be instantly corrected or removed. Can I go on to precession and nutation without a word of what I saw in the Great Exhibition of Philadelphia! In the United States Government part of it Professor Hilgard showed me the measuring rods of the United States Coast Survey with their beautiful mechanical appliances for end measurement, by which the three great baselines of Maine, Long Island, and Georgia were measured with about the same accuracy as the most accurate scientific measurers whether of Europe or Amercia have attained in comparing two metre or yard measures. In the United States Telegraphic Department I saw and heard Elisha Gray's splendidly worked out electric telephone actually sounding four messages simultaneously on the Morse code, and clearly capable of doing yet four times as many with very moderate improvements of detail; and I saw Edison's automatic telegraph delivering 1,015 words in 57 seconds; this done by the long neglected electro-chymical method of Bain, long ago condemned in England to the helot work of recording from a relay, and then turned adrift as needlessly delicate for that. In the Canadian Department I heard "To be or not to be"—"there's the rub," through an electric telegraph wire; but scorning monosyllables, the electric articulation rose to higher flights, and gave me passages taken at random from the New York newspapers as "S. S. Cox has arrived" (I failed to make out the S. S. Cox), "the City of New York," "Senator Morton," "The Senate has resolved to print a thousand extra copies," "The Americans in London have resolved to celebrate the coming 4th of July." All this my own ears heard spoken to me with unmistakable distinctness by the thin circular disc armature of just such another little electro-magnet as this which I hold in my hand, The words were shouted with a clear and loud voice by my colleague-judge Professor Watson at the far end of the line, holding his mouth close to a stretched membrane, such as you see before you here, carrying a little piece of soft iron, which was thus made to perform in the neighbourhood of an electro-magnet in circuit with the line motions proportional to the sonorific motions of the air. This, the greatest by far of all the marvels of the electric telegraph, is due to a young countryman of our own, Mr. Graham Bell, of Edinburgh and Montreal and Boston, now becoming a naturalized citizen of the United States. Who can but admire the hardihood of invention which devised such very slight means to realize the mathematical conception that, if electricity is to convey all the delicacies of quality which distinguish articulate speech, the strength of its current must vary continuously, and, as nearly as may be, in simple proportion to the velocity of a particle of air engaged in constituting the sound. The Patent Museum of Washington, an institution of which the nation is justly proud, and the beneficent working of the United States patent laws, deserve notice in the Section of the British Asociation concerned with branches of science to which nine-tenths of all the useful patents of the world owe their foundations. I was much struck with the prevalence of patented inventions in the Exhibition; it seemed to me that every good thing deserving a patent was patented. I asked one inventor of a very good invention, "Why don't you patent it in England?" He answered, "The conditions of England are too onerous." We certainly are far behind America's wisdom in this respect. *If Europe does not amend its patent laws (England in the opposite direction to that proposed in the Bills before the last two Sessions of Parliament) America will speedily become the nursery of useful inventions for the world.* I ought to speak to you, too, of the already venerable Harvard University, and of the Technological Institute of Boston, created by William Rogers, brother of my Glasgow University colleague, Henry Rogers, the Cambridge of America, and of the John Hopkins University of Baltimore, which with its youthful vigour has torn Sylvester from us, has utilized the genius and working power of Roland for experimental research, and three days after my arrival in America sent for the young Porter Poinier to make him a Fellow. But he was on his death-bed in New York, "begging his physicians to keep him alive just to finish his book, and then he would be willing to go." Of his book, "Thermodynamics," we may hope to see at least a part, as much of the manuscript, and kind and able friends to edit it are left; but the appointment of a fellawship in the John Hopkins University come a day too late to gratify his noble ambition. But the stimulus of intercourse with American scientific men left no place in my mind for framing or attempting to frame a report on American science. Disturbed by Newcomb's suspicions of the earth's irregularities as a time-keeper, I could think of nothing but precession and nutation and settlements of the Equatorial regions, and meltings of Polar ice, and distortions of the earth produced by moon and sun; and so I can give you nothing to-day but a review of evidence regarding the physical conditions of the earth; its internal temperature; the fluidity or solidity of its interior substance; the rigidity, elasticity, and plasticity of its external figure; and the permanence or variability of its period and axis of rotation. The evidence of a high internal temperature is too well known to need any quotation of particulars at present. Suffice it to say that below the uppermost ten metres stratum of rock or soil sensibly affected by diurnal and annual variations of temperature, there is generally found a gradual increase of temperature downwards, approximating roughly in ordinary localities to an average rate of 1 deg. centigrade per 30 metres of descent, but much greater in the neighbourhood of active volcanoes and certain other special localities of comparatively small area, where hot springs, and, perhaps, also sulphurous vapours, prove an intimate relationship to volcanic quality. It is worthy of remark, in passing, that, so far as we know at present, there are no localities of exceptionally small rate of augmentation of underground temperature, and none where temperature diminishes at any time through any considerable gap downwards below the stratum sensibly influenced by summer heat and winter cold. By a simple effort of geological calculus it has been estimated that 1 deg. per 30 metres gives 1,000 deg. per 30 kilometres, and 3,333 deg. per 100 kilometres. This arithmetical result is irrefragable, but what of the physical conclusion drawn from it with marvellous frequency and pertinacity that at depths of from 30 to 100 kilometres the temperatures are so high as to melt all substances composing the earth's upper crust? It has been remarked, indeed, that if observation showed any diminution or augmentation of the rate of increase of underground temperature in great depths, it would not be right to reckon on the uniform rate of 1 deg. per 30 metres, or thereabouts, down to 30, or 60, or 100 kilometres. "But observation has shown nothing of the kind, and, therefore, surely it is most consonant with inductive philosophy to admit no great deviation in any part of the earth's solid crust from the rate of increase proved by observation as far as the greatest depths to which we have reached." Now, I have to remark upon this that the greatest depths to which we have reached in observations of underground temperature is scarcely one kilometre; and that if any falling off of the rate of augmentation of underground temperature were sensible at a depth of one kilometre, this would demonstrte that within the last 10,000 years the upper surface of the earth must have been at a higher temperature than that now found at the depth of one kilometre. Such a result is, no doubt, to be found by observation in places which have been overflown by lava in the memory of man or a few years further back; but if it were found for the whole earth, it would limit the whole of geological history to within 10,000 years, or, at all events, would interpose an absolute barrier againt the continuous descent of life on the earth from earlier periods than 100,000 years ago. Therefore, although search in particular localities for a diminution of the rate of augmentation of underground temperature in depths of less than a kilometre may be of intense interest, as helping us to fix the dates of extinct volcanic actions which have taken place within 10,000 years or so, we know enough from thoroughly sure geological evidence not to expect to find it, except in particular localities, and to feel quite sure that we shall not find it under any considerable portion of the earth's surface. If we admit as possible any such discontinuity within 900,000 years, we might be prepared to find a sensible diminution of the rate at three kilometres' depth, but not at anything less than 30 kilometres if geologists validly claim as much as 90,000,000, of years for the length of the time with which their science is concerned. Now, this implies a temperature of 100 deg. Cent. at the depth of 30 kilometres, allows something less than 2,000 deg. for the temperature at 60 kilometres, and does not require much more than 4,000 deg. Cent. at any depth, however great, but does require at the great depths a temperature of, at all events, not less than about 4,000 deg. Cent. It would not take much "hurrying-up" of the actions with which they are concerned to satisfy geologists with the more moderate estimate of 50,000,000 of years. This would imply, at least, about 3,000 deg. Cent. for the limiting temperature at great depths. If the actual substance of the earth, whatever it may be, rocky or metallic, at depths of from 60 to 100 kilometres, under the pressure actually there experienced by it, can be solid at temperatures of from 3,000 deg. to 4,000 deg., then we may hold the former estimate (90,000,000) to be as probable as the latter (50,000,000), so far as evidence from underground temperature can guide us; if 4,000 deg. would melt the earth's substance at a depth of 100 kilometres, we must reject the former estimate, though we might still admit the latter; if 3,000 deg. would melt the substance at a depth of 60 kilometres, we should be compelled to conclude that 50,000,000 of years is an over estimate. Whatever may be its age, we may be quite sure the earth is solid in its interior; not absolutely throughout its whole volume, for there certainly are spaces in volcanic regions occupied by liquid lava; but whatever portion of the whole mass is liquid, whether the waters of the ocean or melted matter in the interior, these portions are small in comparison with the whole; and we must utterly reject any geological hypothesis which, whether for explaining underground heat or ancient upheavals and subsidencies of the solid crust, or earthquakes, or existing volcanoes, assumes the solid earth to be a shell of 30 or 100, or 500, 1,000 kilometres thickness, resting on an interior liquid mass. This conclusion was first arrived at by Hopkins, who may, therefore, properly be called the discoverer of the earth's solidity. He was led to it by a consideration of the phenomena of precession and nutation, and gave it as shown to be highly probable, if not absolutely demonstrated, by his confessedly imperfect and tentative deduction, but a rigorous application of the perfect hydrodynamical equations leads still more decidedly to the same conclusion. But, interesting in a dynamical point of view as Hopkins's problem is, it cannot afford a decisive argument against the earth's interior liquidity. It assumes the crust to be perfectly stiff and unyielding in its figure. This, of course, it cannot be, because no material is infinitely rigid: but, composed of rock and possibly of continuous metal in the great depths, may the crust not as a whole be stiff enough to practically fulfil the condition of unyieldingness? No; decidedly it could not; on the contrary, were it of continuous steel and 500 kilometers thick, it would yield very nearly as much as if it were india-rubber, to the deforming influences of centrifugal force and of the sun's and moon's attractions. Now, although the full problem of precession and nutation, and what is now necessarily included in it—tides, in a continuous revolving liquid spheroid, whether homogenous or heterogeneous, has not yet been coherently worked out, I think I see far enough towards a complete solution to say that precession and nutations will be practically the same in it as in a solid globe, and that the tides will be practically the same as those of the equilibrium theory. From this it follows that precession and nutations of the solid crust, with the practically perfect flexibility which it would have, even though it were 100 kilometers thick and as stiff as steel, would be sensibly the same as if the whole earth from surface to centre were solid and perfectly stiff. Hence precession and nutations yield nothing to say, against such hypotheses as that of Darwin, that the earth as a whole takes approximately the figure due to gravity and centrifugal force, because of the fluidity of the interior and flexibility of the crust. But alas for this "attractive sensational idea that a molten interior to the globe underlies a thin superficial crust; its surface agitated by tidal waves and flowing freely towards any issue that may here and there be opened for its outward escape," as Poulett Scrope called it. The solid crust would yield so freely to the deforming influence of the sun and moon that it would simply carry the waters of the ocean up and down with it, and there would be no sensible tidal rise and fall of water relatively to land. The state of the case is shortly this:—The hypothesis of a perfectly rigid crust containing liquid violates physics by assuming preternaturally rigid matter and dynamical astronomy in the solar semi-annual and lunar fortnightly nutations; but tidal theory has nothing to say against it. On the other hand, the tides decide against any crust flexible enough to perform the nutations correctly with a liquid interior, or as flexible as the crust must be unless of preternaturally rigid matter. But now thrice to slay the slain; suppose the earth this moment to be a thin crust of rock or metal resting on liquid matter. Its equilibrium would be unstable. And what of the upheavals and subsidences? They would be strikingly analogous to those of a ship which has been rammed; one portion of crust up and another down, and then all down. I may say with almost perfect certainty that, whatever may be the relative densities of rock solid and melted, at or about the temperature of liquefaction, it is, I think, quite certain that cold solid rock is denser than hot melted rock; and no possible degree of rigidity in the crust could prevent it from breaking in pieces and sinking wholly below the liquid lava. Something like this may have gone on and probably did go on for thousands of years after solidification commenced; surface portions of the melted material losing heat, freezing, sinking immediately, or growing to thicknesses of a few metres when the surface would be cool and the whole solid dense enough to sink. "This process must go on until the sunk portions of crust build up from the bottom a sufficiently close-ribbed skeleton or frame, to allow fresh incrustations to remain bridging across the now small areas of lava pools or lakes. In the honey-combed solid and liquid mass thus formed there must be a continual tendency for the liquid, in consequence of its less specific gravity, to work its way up, whether by masses of solid falling from the roofs of vesicles or tunnels, and causing earthquake shocks, or by the roof breaking quite through when very thin, so as to cause two such hollows to unite or the liquid of any of them to flow out freely over the outer surface of the earth; or by gradual subsidence of the solid owing to thermodynamic melting, which portions of it under intense stress must experience according to my brother's theory. The results which must follow from this tendency seem sufficiently great and various to account for all that we learn from geological investigation of earthquakes, of upheavals, and subsidences of solid, and of eruptions of melted rock." Leaving altogether now the hypothesis of a hollow shell filled with liquid, we must still face the question, how much does the earth, solid throughout, except small cavities or vesicles filled with liquid, yield to the deforming (or tide generating) influences of sun and moon? This question can only be answered by observation. A single infinitely accurate spirit level or plummet far enough away from the sea to be not sensibly affected by the attraction of the rising and falling water, would enable us to find the answer. But there are large annual and semi-annual changes of sea level, probably both differential, on account of wind and differences of barometric pressure and differences of temperature of the water, and absolutely depending on rainfall and the melting away of snow, and the return evaporation, which altogether swamp the small semi-annual and annual tides due to the sun's attraction. Happily, however, for our object there is no meteorolgical or other disturbing cause which produces periodic changes of sea-level in either of the fortnightly decinational or the monthly elliptic period; and the lunar gravitational tides in these periods are therefore to be carefully investigated in order that we may obtain the answer to the interesting question, how much does the earth as an elastic spheroid yield to the tide-generating influence of sun or moon? Hitherto in the British Association Committee's reductions of tidal observations we have not succeeded in obtaining any trustworthy indications of either of these tides. The Prince's Pier landing-stage pontoon, unhappily chose for the Liverpool tide guage, cannot be trusted for such a delicate investigation; the available funds of calculation were expended before those—the long period tides—for Helbre Island could be attached, and three years of Kurrachee gave our only approach to a result. Comparisons of this, with an indication of a result which calculations on West Hartlepool tides, at the expense of the Royal Society, seem to show possibly no sensible yielding, or perhaps more probably, some degree of yielding, of the earth's figure. The absence from all the results of any indication of a 18·6 yearly tide (according to the same law as the other long-period tides) is not easily explained without assuming or admitting a considerable degree of yielding. Closely connected with the question of the earth's rigidity, and of as great scientific interest and even greater practical moment, is the question—how nearly accurate is the earth as a timekeeper? and another of, at all events, equal scientific interest—how about the permanence of the earth's axis of rotation? Peters and Maxwell, about 35 and 25 years ago, separately raised the question, how much does the earth's axis of rotation deviate from being a principal axis of inertia? and pointed out that an answer to this question is to be obtained by looking for a variation in latitude of any or every place on the earth's surface in a period of 306 days. The model before you illustrates the travelling round of the instantaneous axis relatively to the earth in an approximately circular cone whose axis is the principal axis of inertia, and relatively to space in a cone round a fixed axis. In the model the former of these cones, fixed relatively to the earth, rolls internally on the latter supposed to be fixed in space. Peters gave a minute investigation of observations at Pulkova in the years of 1841-42, which seemed to indicate at that time a deviation amounting to equal to about 3-40 seconds of the axis of rotation from the principal axis. Maxwell from Greenwich, found seeming indications of a very slight deviation—something less than half a second—but differing altogether in phase from that which the deviation indicated by Peters, if real and permanent, would have produced at Maxwell's later time. On my begging Professor Newcomb to take up the subject, he kindly did so at once, and undertook to analyse a series of observations suitable for the purpose, which had been made in the United States Naval Observatory, Washington. A few weeks later I received from him a letter referring me to a paper by Dr. Nysen, of Pulkova Observatory, in which a negative conclusion as to constancy of magnitude or direction in the deviation sought for is arrived at from several series of the Pulkova observations between the years 1842 and 1872, and containing a statement of his own conclusions, which were also negative. From the discordant character of these results we must not, however, infer that the deviations indicated by Peters, Maxwell, and Newcomb are unreal. On the contrary, any that fall within the limits of probable error of the observations ought properly to be regarded as real. There is, in fact, a *vera causa* in the temporary changes of sea level due to meteorological causes, chiefly winds, and to meltings of ice in the polar regions, and return evaporations, which seems amply sufficient to account for irregular deviations of from one-halt to 1-20th seconds of the earth's instantaneous axis from the axis of *maximum* inertia, or, as I ought rather to say, of the axis of *maximum* inertia from the instantaneous axis."

The conclusion of the address was occupied with the estimated tidal retardation of the earth's rotation, causing it to go slower (regarded as a timekeeper) at the end of a century by half a second per annum than at the beginning of the century; and with some startling results of Newcomb's recent investigations in the lunar theory, seeming to show strange irregularities in the earth's time keeping.

The address was received with cheers, and a vote of thanks was accorded to Sir William Thompson. Papers were afterwards read by Professor James Thompson giving experimental illustration of the origin of windings of rivers in alluvial plains; by Mr. James Croll, on the transformation of gravity; by Professor James Thompson, on metric units of force, energy, and power, larger than those on the centimetre gram second system; by Sir W. Thompson, on precessional motion of a liquid, or a new form of astronomical clock, with free pendulum actuated by independent governor, to give approximately correct uniform motion to escapement wheel, and on compass correction in iron ships.

GEOLOGY.—In this section, Professor John Young, M.D., presided. There was a very large attendance, the spacious classroom being filled during the whole day. Among those present were the President of the Association, Dr. Andrews, the Duke of Argyll, the Bishop of Down and Connor, Dr. Hooker, Professor Geikie, Professor Williamson, Professor Hull, Mr. Topley, Dr. Milne Hulme, Mr. T. Sopwith, the Rev. Dr. Jamieson, the Rev. D. J. E. Cumming, the Rev. W. Symonds, &c.

The first business was the President's address, which was received with cheers.

The address of Professor Young was devoted to a criticism of current geological terminology. The aim of the paper was to show that the need for a great extension of geological time was rather due to the biologists than the geologists; the former requiring more time for organic evolution than seemed to be covered by the migration of species and their modification in transit. The assumptions to which Dr. Young chiefly referred were, that there were, necessarily fossiliferous strata anterior to the Lementian, and that the missing strata made up an important thickness of rock. He further gave reasons for doubting whether we are yet in a position to give even approximate guesses at the time needed for the denudation and deposit of any given thickness of rock, and deprecated the notion that astronomers and physicists had exhausted the possibilities of secular changes. He looked to the rising school of geologists, who were besides competent mathematicians and physicists, for the most important advance to be looked for in the immediate future. Thanks having been voted to the Professor,

The Duke of Argyll read a very interesting paper on the Physical Structure of the Highlands, in connexion with their geological history, in which he referred to the West of Scotland; in the capital of which we are assembled, is not rich in deposits which illustrate the passage of animal life from the types which have become extinct to those which are of more modern origin and which still survive. No bone caverns have been discovered of importance, and, with one exception, however, river gravels and estuarine deposits have not been especially productive. That exception is, indeed, a feature. It was in his valley of the Clyde that the late Mr. Smith, of Jordan-hill, first discovered those indications of antarctic climate recently prevailing which have ever since constituted a large and important branch of geology, and the full interpretation of which still presents some of the most curious problems with which we have to deal. But our palæozoic areas, except the coal measures, are to a large extent singularly unfossiliferous; neither the Scottish oolite nor lias have yielded any remarkable additions to the curious fauna of which in England and elsewhere they have yielded abundant specimens. But, on the other hand, perhaps no area of country of equal extent in any quarter of the world presents more remarkable phenomena than the West of Scotland in connexion with those causes of geological change which have determined the form of the earth's surface, and have given to its physical geography those features of variety and beauty which are the increasing delight of civilized and instructed men. His Grace then proceeded to the consideration of the various geological features of the country, stating that it would, I think, be affectation to pretend that our science enables us to follow with anything like distinctness of conception the exact nature and sequence of operations which through such a vast lapse of time had brought about the final result, but I believe in something like the following general outline of events:—First, that subsequent not only to the consolidation, but probably also to the metamorphism of the lower silurian deposits, the whole area of the western and central Highlands became an area. That kind of disturbance arose from lateral pressure, due to secular cooling, and consequent contraction and subsidence of the crust of the earth. Second, that the crumpling contortion and tilting of the silurian beds which we now see arose from that disturbance. Thirdly, that then were determined those great general lines of strata running from north-east to south-west, which are to this day a prominent feature in the physical geography of the country. Fourthly, that during that period of disturbance, and as part of the movement which then took place, the disturbed rocks fell inwards upon materials at a great heat, which rose in a pasty state along the lines of least resistance, and thus came to occupy the various positions sometimes interpolated among the sedimentary beds. Fifthly, that to this period, and to this method of protrusion, we owe some at least of the measures of granitic material which are abundant in the Highlands in particular; that to this period belongs the porphyritic granites on the north shores of Loch Fyne. Sixthly, that during the later ages of the palœozoic period volcanic action broke out at various points, accompanied by great displacement and dislocation of strata, and that to this, with the denudation which followed, we owe much of the very peculiar scenery of the south-western coasts, especially in the district of Lorne, in Argyleshire. Seventh, that we have no proof that the Central Highlands were ever under the seas which laid down the deposits of the later palœozoic age. Eighth, that such evidence as we have points rather to the conclusion that they were not under those seas, since such fragments as remain of the old red and carboniferous rocks appear to have been deposited round the bases and in the marginal hollows of the silurian rills. Ninth, that, in like manner, we have no evidence that the great mass of the Western or Central Highlands were ever under the seas of the secondary ages, which, on the contrary, appear to have deposited their sediment upon an area outside of, but probably surrounding, the area of those Central Highlands, and certainly upon the eastern and western flanks. Tenth, that the whole area of the inner Hebrides and of the waters dividing them, together with some portion of the mainland, as in Moven, was an area occupied by secondary rocks. Eleventh, that in the tertiary ages—probably in the socene and certainly in the miocene—those rocks formed the bases of a great land of unknown extent, very probably extending for a great distance both to the east and west of the present coasts of Scotland and embracing the north of Ireland. Twelfth, that this country became in the miocene age and possibly has been the scene of great volcanic outbursts, which covered it in the vast sheets of lava and broke up its sedimentary rocks with every form of intrusive plutonic matter. Thirteenth, that later in the tertiary periods and perhaps as late as the pleiocene this volcanic country was itself broken up by immense subsidences and upheavals, giving both occasion and direction to the agencies of denudation and to enormous removal of material. Fourteenth, that this tertiary country had been thus broken up and nothing but its fragments left when the glacial epoch began, and that the main outlines of the country as we now see it had been already determined when glacial conditions were established. Fifteenth, that thus the work of the glacial period has been simply to degrade and denude pre-existing hills and to deepen pre-existing valleys. Sixteenth, that during the glacial epoch there was a subsidence of land to the depth of at least 2,000ft. above the level of the present sea, and again a re-elevation of the land to its present level. Seventeenth, that this re-elevation has not restored the land to the level it stood at before the subsidence began; but has stopped greatly short of it, and that the deep arms of the sea, or lochs, which intersected the country and some of the deeper fresh water lakes, such as Loch Lomond, are the valleys still submerged which at the beginning of the glacial epoch were high above the sea and furrowed in flanks of loftier mountains; that during the glacial period the work of denudation and degradation was done, and done only, by ice. In conclusion, his Grace said, "Let me repeat that, whether this conclusion is correct or not—and I am well aware of the many difficulties which surround it—the general fact of submergence and re-elevation is, perhaps, as certain as any conclusion of geological science, and that the consequences of it in accounting for the distribution of gravels and the most recent changes of deundation have never as yet been worked out with anything approaching to consistency or completeness.".

Professor Geikie, F.R.S., remarked that those who had watched recent discussion in physiographical geology might have been prepared, as he himself was, for a much greater divergence of opinion between the views expressed by the Duke of Argyll and those entertained by the younger school of geologists. While expressing his gratification at this approach, and at the very clear and eloquent views of the author of the paper, he ventured to point out some points where the arguments seemed faulty. He showed that the Highlands might have been covered with old red sandstone, and that the antiquity of the present mountains could not be traced back to the primeval upheaval to which undoubtedly the general mass of Highland land was due. He pointed out that the absence of raised beaches could not be regarded as a disproof of the former presence of the sea, but indicated a period of pause during either a rapid or protracted upheaval.

Professor Harkness fully agreed in what Professor Geikie had said in reference to the great value of the communication of his Grace. There were, however, some points to which he must take exception. He considered that the arrangement of the strata which form the metamorphic rock of the Highlands was not so difficult to unravel as some inferred. The southern portion of the series in many spots afforded clear section of the sequence and contortions, and he would specially refer to the section between Loch Ky and Glen Lyon. This section afforded clear evidence of mountains lying in a synctinal trough, a circumstance which could not be accounted for by contortions producing hills and valleys. He also agreed with Professor Geikie in considering that the old red sandstone formerly covered a very large portion of the metamorphic rock, and he was more disposed to refer the outline of the Highland to superficial denudations than elevations or subsidencies of metamorphic strata. He referred to the importance of an investigation of the glaciation of the Outer Hebrides in any effort to solve the glaciation of the Highlands and Islands. He had for several years taken observations in these islands in regard to this subject, and the conclusions he had come to were that the whole of these outer islands had been glaciated from the Atlantic to the West; secondly, that during the period of submergence in the glacial epoch icebergs and floes had dropped blocks on all our islands, many of which were finally perched; thirdly, he thought that local glaciers had also existed in Harris, at least, if not in South Uist. The glaciation of the Outer Islands was remarkably fine and should be visited by all interested in the glaciation of Scotland. Mr. Thomson had examined the conglomerates from the Mull of Kintyre to Loch Inver, in Ross-shire, and had never found a single section of the strata that contained similar pebbles and boulders to those found on the shores of Jura and Islay. He could not agree with Mr. Jolly in saying that the drifted boulders found in the Island of Lewes had all dritted from the West. Many were traceable to the main land Cambrian age, and found in Gare Loch and neighbourhood. In reference to the fluxures of the valleys he quite agreed with his Grace, and referred to Sarbert Lochfine, where there was one great flexure, rocks being contorted and broken up into every conceivable aspect; the great depth of water in Lochfine inducing the belief that the contour of the country was established previous to the deposition of the mesozoic rocks.

The Rev. H. W. Crosskey remarked that the general glacial phenomena of Scotland could be explained without recurrence to the ice sheet. These phenomena were largely connected with local conditions. The absence of any positive marks or sea beaches was no proof against submergence. In many cases a small deposit accidentally discovered proved the submergence of miles of country. Some great salient facts in the order of events stood fairly established. In the first instance the land stood at a higher level. This was proved by remains of rivers beneath boulder clay, and other facts. Subsidence then occurred, and glacial shell clays were deposited. Owing to subsequent re-elevation a slight subsidence probably again took place previous to the final upheaval. As regards the last upheaval, he held that it took place gradually. Examination of the clays showed a quick passage from marine to estuarine conditions. He agreed with his Grace that the last upheaval was probably at a recent period, but it must be remembered that the highest beds of fossils of the series consisted of glacial forms. He asked attention to the great general order of the succession of beds.

Professor W. C. Williamson, as a student of the Midland drifts, was surprised at the apparent agreement among the Scotch geologists in their non-recognition of Agassiz's ice sheet. He was not able to acquiesce in their views on two grounds. The question turned upon the meaning of the terms glacieta and ice sheet, which were terms representing relative magnitudes. The ice covering of Greenland was practically an ice sheet, and yet that it must have a coastward motion was shown by the icebergs which continually and through long ages broke away from it without reducing its area. In the like manner the Antarctic ice along which the Erebus and Terror sailed for hundreds of miles without break, more than mast high above the water, and seven or eight times that amount below it, must have a similar motion. Again, the condition of the lower sill, a true *moraine profonde*, devoid of all traces of marine life, could not be explained except on the supposition of a sub-glacial origin, a position which all life was excluded, a condition intelligble on the supposition of formation under a broad ice sheet.

Mr. Gwyn Jeffreys and Mr. Pengelly also took part in the discussion. The Duke of Argyll briefly replied, and thanks were accorded to his Grace for his interesting paper.

ECONOMIC SCIENCE AND STATISTICS.—The section of Economic Science and Statistics met in the Greek class room. Sir George Campbell, President of the section, was supported on the platform by Lord O'Hagan, Mr. James Heywood, F.R.S., Dr. Jack, Sir Rawson Rawson, K.C.B., Mr. R. F. Fellowe, Mr. Edwin Chadwick, C.B., Mr. J. Murch, Mr. G. H. Bohn, and Dr. Beddow, F.R.S. There was a good attendance of members of the Association.

The President opened the proceedings by reading his address, of which the following is an abridgment :—After adverting to the value of statistics, and remarking that it is especially necessary to distinguish between figures which are really ascertained and those which are merely drawn by deductions from rough and conjectural facts, he added :—In my own experience I have been particularly struck by the light thrown on our institutions by a comparison with those lately and now existing among the different peoples of India. Of the history and use of local institutions we may learn very much in India. That country was, locally speaking, one of the most self-governed countries in the world in native times. In all parts of this island, while the civic constitutions of the ancient burghs have been preserved, the self-governing institutions of the country at large have almost entirely disappeared, leaving only a few fossil remains to testify to their previous existence. On the continent of Europe the old communes retain a good deal of vitality, but it is in India under native rule that we see these institutions in full vigour and working order. That little Republic, the village community of India, has come to be looked on as an interesting old relic, rather than as the subject for modern imitation. In my opinion we may draw from it a very large store of economic knowledge which may be very useful to us. I believe that the more we introduce into India true economic science the more it will be apparent that we have taken on ourselves too heavy a burden—that too great a centralization is a mistake, and that in a country where political freedom on a large scale is impossible, the only satisfactory resource is a large measure of the local government to which the people are accustomed. The tenure of land is another subject on which great light is thrown by Indian experience. After an intimate acquaintance with the tenures which we there find in existence and those which our system has created, we seem to have before us a picture of the rise and progress of property in land. Among the communities holding land we have manifest traces of the old system of partition and re-partition; we have before our eyes the gradual decrease of that old system and the gradual growth of the individual tenure of the lands under the plough, with common use of the pasture lands, the wood, and the water on a tenure strictly analogous to that of English commons, we have the struggles between the Lords and the Commoners, and questions between the Commoners and the landless members of the community just as we have had in this country; then we have the growth of English ideas of property in land; we have the overlord, the Zemindar no longer holding in feudal tenure, and receiving customary dues and services, but turned by us into a rent receiver; we have the struggle of the rent receiver influenced by our ideas to turn the privileged cultivator into a tenant pure and simple to appropriate the commons and to establish absolute property; we have the emancipation of some cultivators and copyholders the subsidence of others put unto rackrented tenants at will, and then into labourers. All these stages in the tenure of land we have in the Indian countries where the Zemindar system has prevailed. In other parts of India where the Government has recognised the rights of and dealt with the ryots direct we have the rapid development of small property in land in all the incidents of that form of property in which in many parts of Europe we are familiar. The subject of small cultivation seems to derive a new interest from what is now going on in regard to the emancipated Africans in the the United States of America and elsewhere. I understand that the cultivation which has already made the produce of the American cotton districts almost or quite equal to that before the war is for the most part the cultivation of small independent negro cultivators, who raise cotton on a system much the same as that under which the ryots of India or *metayers* of Italy cultivate small farms. There seems to be among the dark races of India and Africa a dislike to regular hired labour and a preference for independent labour on their own account, which makes them prefer small farming to service, or at all events leads to their doing better work on their own farms. There has been, I think, a disposition to undervalue the agricultural skill of the Indian ryot, and if it should prove that in advanced America, under free institutions, the cultivation of an article of great value and high quality is best carried on by small black farmers, we may well believe that in other countries, too, great results may be obtained by the same system. The settling down to honest labour of the American freedmen is an example full of promise, I hope, for the African race throughout the world. If in all the countries where the state of black freedmen is still uncertain they can be thus settled, a great end will be achieved, and in Africa itself we may hope that in countries now torn by war and slavery a guiding hand may lead the African race to peaceful, prosperous, and happy times. Very intimately connected, too, with this question is that great and most difficult subject of pauperism. Poor Indian ryots manage to get on without poor laws, because they are prudent self-workers; the poor Irish farmers for the most part do the same. In most European countries there are no poor laws, yet when the people of the country are reduced to the position of labourers poor laws become a necessity. (Hear, hear.) It is found in practice that people living on wages do not make the same provision for themselves and their helpless relations that self-workers do. (Hear, hear.) There has been a strong disposition to meet this tendency by a more severe administration of the poor laws by driving poor people into the workhouse. I confess that I doubt the efficacy of this system. At any rate, I think it may be carried too far, and I was glad to hear Mr. Walter, of the *Times*, make a manly stand against it in his place in the House of Commons. (Cheers.) At the same time, I admit that there are two sides to the question, and I expect some important discussion upon it in this Section on to-day. It is for us to treat the matter scientifically and to consider the principles on which poor relief is founded. The Scotch are a logical people, and they are inclined to take the view that payments to the poor rates are a kind of insurance. They pay rates when they are well to do, and they think they are well entitled to pensions from the rates when they are disabled. Is this view a correct one, or, if not, what is the real principle of poor-rates and poor relief? I think that these are questions which must be answered by those who would take a severe view of the relief system. I am inclined to doubt whether English *doctrinaires* or Central Boards can much improve on our careful and prudent system of out-door relief administered by local bodies who thoroughly know their own people. (Hear hear.) He would be a bold man, indeed, who would prophesy the value of silver, and compared with gold a few years hence, I shall certainly not attempt to do so. There are countries, China especially, of which we know very little; and I apprehend that the course of the silver market will very greatly depend on the action of the States of the Latin Union and the United States of America. The disposition of the Government of India seems to be to adopt a waiting policy, and there are not sufficient *data* to enable any one to pronounce with confidence that this course is wrong. "When in doubt what to do, try how it will answer to do nothing," is a maxim of much value. The only plan to which personally I have a little inclined is to put more silver into the rupee, and that would not be safe till we are sure that the change in the relative value of the precious metals is permanent. On one point only in connection with this subject I should like to say something further. The belief has been expressed, and the Silver Committee has accepted the suggestion, that India is likely to absorb an increased and increasing quantity of silver for currency purposes. This I greatly doubt. It is said in many parts of India that silver is yet little known for purposes of exchange, most transactions being conducted by the primitive method of barter. This, I think, quite a mistake. I have as wide an experience of India as most men, and I know no part of India where traffic is by barter for want or ignorance of coin, except the most remote Hill regions of the most savage and unexplored Aboriginal tribes which are yet hardly known even geographically. The Hindoos are a very old people; they used coin freely when we had none, and they have not forgotten the use of it. I should say that the special feature of their transaction is the use of a great deal of coin in cases where we should use notes, checks, or bills, and my impression is the opposite of that which has been suggested. When I first went to India very large quantities of coin were hoarded. Every prosperous native Prince who managed his finances well according to native ideas hoarded very large sums in coin. On the occasion of successions, minorities, and otherwise, we ascertained the reality of these hoards, and the weight and power of a prince or noble was estimated by his store of treasure. So in grades below there was much disposition to put by stores of rupees, and the prosperous peasant, like the Frenchman, either buried rupees in his hut or made them into ornaments for his family—a little capital to be converted into cash when necessity arose. Till very recently paper money was wholly unknown, and even yet it is used only to a very minute degree compared with its use in European countries. Now that the country is more opened up every day, that there is confidence in British peace, that new channels of enterprize, new wants and ideas are developed, I believe that the habit of hoarding coin diminishes, and that native Princes and nobles spend their money in many new ways. When they accumulate they lend it to the British Government to make railways in their territories or undertake enterprises of their own or put it in "Government paper;" smaller people travel by railway, enter into speculations, and utilize their money instead of hoarding it. In one direction, as people become richer, the ornaments on their wives and children may become more valuable; but in another direction there is less hoarding of capital in this form. In a country where the coin of legal tender is so bulky as silver, there is much greater occasion to use paper money freely than where the currency is gold. I see not why, as confidence in our notes increases, that they may not come to be used 10 or 20 or 50 times as much as at present—why notes for large sums and silver for smaller sums should not constitute the currency for transactions for which copper suffices. If the tendency of things should be at all in the direction which I have indicated, it would follow that while we might understand the absorption of a vast amount of silver in the past century, we might also suppose that the tendency thus to absorb that metal would continue. As education fits a man for his duty in the scheme of economy, so dissipation of various kinds unfits him, and we can hardly exclude from economic science the effect of the abuse of stimulants —I was going to say use and abuse, but I think it may be doubtful whether there is any real use for stimulants at all. The address then referred to the comparative effects of pure stimulants and narcotics. The remainder of the address referred to the advantage of codification of the law and criminal jurisprudence, in which he thus refers to flogging as a punishment. After a great experience I am myself much convinced that of all forms of corporal punishment flogging is the most uncertain, ineffective, and dangerous. In a light and simple form it is good for juvenile delinquents, whose offences are petty and whom we would not contaminate by a first imprisonment, and flogging is to some natures a material addition to other punishments; but as soon as we try to carry it beyond this we are placed in this dilemma—that a flogging which is safe is an insufficient punishment. A more severe flogging is a sort of lottery. Nineteen or 99 men it may not harm; the twentieth or hundredth it will kill.

Lord O'Hagan proposed the cordial thanks of this Assembly be offered to Sir George Campbell for the address which you have heard.

Mr. James Heywood seconded the motion, which was adopted by acclamation.

Sir George Campbell having briefly acknowledged the compliment,

Mr. Heywood read the report of the Metric Committee, which recommended the introduction of an uniform system of weights and measures.

Mr. Fellows moved the adoption of the report. The law had declared the metric system legal, but had not made provision for verification according to the standards.

Mr. E. Chadwick seconded the motion.

A short discussion ensued, some members being of opinion that as they had made little or no progress on the question it should be dropped for at least ten years, and others that the committee should be re-appointed. The report was received without binding the section to everything it contained, the chairman expressing a hope that in the meantime steps should be taken for the unification of our own weights and measures. If the American dollar were so treated that five should go to the pound, if five francs should go to the dollar, and if they put a little more silver in the rupees, so that ten rupees might go to the pound, important steps would be taken towards a uniform system of international coinage.

Two papers were next read by Mr. W. Tullack, on the boarding out of pauper children in England; by Mr. A. M'Neel Caird on some special evils of the Scottish Poor Law.

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President, SIR ANTONIO BRADY.

TO MEMBERS OF COUNCIL.

The Session 1875-6 being ended, Council meetings according to notices, which will be sent by post.

Subscriptions are payable to Mr. G. A. Stretton, the Receiver, 4, St. Martin's-place, S.W., who is the proper official to give receipts.

F. W. Campin, Sec.

Proceedings of the Institute.

The usual monthly meeting of the Executive Council of the Institute was summoned on the 31st August at the Secretary's Office, 46, Southampton-buildings, Chancery-lane, but August being one of the vacation months of the Institute, no special business was transacted. The Secretary was, however, directed to apply to various members residing in or near Glasgow, asking them to attend the meeting of the British Association, and watch the proceedings of that body on the Patent Laws. The official announcement of several new members terminated the proceedings.

Monthly Notices.

Another small planet was, according to a recent telegraphic announcement, discovered by Prof. Peters, of Hamilton College, Clinton, U.S. This raises the number of that astronomer's planetary discoveries to *twenty-five*. And the Atlantic cable conveyed intelligence, on August the 30th, of the discovery of still another small planet by Prof. Peters, which will reckon as No. 167, and is the tenth found since the commencement of this year.

Dr. Asa Gray, the eminent American botanist, has collected his essays on the Darwinian theory into a volume, under the title of "Darwiniana: Essays and Reviews pertaining to Darwinianism." Dr. Gray is well known as a firm though discriminating supporter of Mr. Darwin's views.

The Report of the Meteorological Committee of the Royal Society for 1875 has just been published. The Report shows that considerable attention has been paid to ocean meteorology; that the arrangements for weather telegraphy are now fairly complete, and that the land meteorology of the British Islands continues in operation without material change.

For future meetings of the British Association the General Committee has determined to so arrange the commencement of the sectional meetings that the presidential addresses shall not be delivered simultaneously in the several sections. The effect of this regulation will be to give members an opportunity of hearing more than one of these addresses. Dr. Allen Thomson, Professor of Anatomy in the University of Glasgow has been nominated President-elect of the British Association. The next meeting will be held at Plymouth in August, 1877.

The death of the eminent microscopist, Dr. Christian Gottfried Ehrenberg, of Berlin, who died on the 27th of June, at the age of eighty years, is announced by the German journals.

A recent number of the Proceedings of the Royal Society contains a paper embodying the results of the monthly observations of magnetic dip, horizontal force, and declination, made at the Kew Observatory from April, 1869, to March, 1875, inclusive. It is the third six-year series of magnetic observations made there, the first being communicated to the Society by Sir E. Sabine, and published in the *Philosophical Transactions* for 1863. The progressive diminution in the value of the dip continues to be shown, as well as a semi-annual inequality, which appears to be of variable amount. The total magnetic force, as in both the previous series, is greater in the winter (October to March) than in the summer (April to September) period. In the series now under discussion, the measure of that greater intensity is 0·00500; whilst in the first series investicated by Sir E. Sabine, it was 0·00317; and that in the second six-year series, 1863 to 1869, was 0·00363. The observations of the absolute declination show a continuous diminution of about 8′ per year; comparing which with that determined by Sir E. Sabine, it appears to be on the increase, as was surmised before. The semi-annual inequality is also considerably larger.

Silver discoveries have (we learn from the *Scientific American*) been made in the vicinity of Arthur's Landing, on the north shore of Lake Superior, about 200 miles north-east of Duluth. A miner dropped down upon some crumbled quartz containing native silver. The rock is expected to yield 3,500 dols. or 5,000 dols. per ton.

The Crystallized Glycerin, exhibited by Dr. Armstrong at the Chemical Society, London, is well worthy of attention, we therefore now notice it. The solidification took place while the glycerin was being agitated on a railroad journey in cold weather last winter. Dr. Odling mentioned the curious fact that hydrocyanic or prussic acid is an excellent test for the purity of glycerin, the slightest admixture of any foreign substance causing the glycerin to turn yellow in a short time if a little hydrocyanic acid be stirred into the liquid.

Reviews.

DR. WHITE'S WARFARE OF SCIENCE.

"The Warfare of Science." By Andrew Dickson White, LL.D. With Prefatory Note by Prof. Tyndall. London: H. S. King and Co.

Polemics in science and theology will find in this work a most temperate and agreeable contribution to the apparently never-ending controversy as to their antagonism. Dr. White shows by a historical survey, that "in all modern history interference with science in the supposed interest of religion, no matter how conscientious such interference may have been," has done no good. The two principal chapters, as might be expected, are those of geology and astronomy. The story of the Copernican astronomy and Galileo is well told.

Dr. White gives us not only the facts of Galileo's condemnation, but the explanations put forward in later times by some of the apologists of the Church of Rome. One suggestion is that the popular notion of the proceedings is all a mistake, and that it was a mere question of contempt of court; which is against all the evidence. Another is that the condemnation was not *ex cathedra*, nor the act of the Church, but a mere act of the Pope in his fallible capacity; however, this has the disadvantage of being against the whole weight of contemporaneous understanding and a good deal of subsequent affirmation by high authorities. The third proposition is, that if the Church did go wrong, it was not her fault, but arose from the difficulty in the Scriptures themselves, containing words which have every appearance of denying the earth's motion. This is a fine commentary on the verity of the dogma of infallibility!

The suppression of Roger Bacon's researches Dr. White pertinently puts forward as a robbery of the nineteenth as well as the thirteenth century. Dr. White does not limit his attention to the doings of the Roman Church, for he asks us to note "how, down to the present time, the two great universities of Protestant England . . . have excluded the natural and physical sciences as far as possible."

CASSELL'S DICTIONARY OF COOKERY.

"Cassell's Dictionary of Cookery," with numerous Engravings and full coloured Plates. Part IX. Petter and Galpin. London, Paris, and New York.

The present part of this valuable work fully equals the high character of its predecessors. As we must all eat, and many of us cannot eat without having something appetising, yet wish to partake of wholesome food, cookery is by no means one of those insignificant questions that may well be left to the household drudges; moreover, it is a branch of practical chemistry, and as much entitled to receive attention as regards its technical educational aspect as any of the occupations of civilized life. As the work progresses it becomes more and more apparent that the regular dictionary form is the most useful that could have been adopted; but though the arrangement is good the matter is equally good, as the following extract will prove:—

"Ptarmigan Salad.—Take the remains of cold roast ptarmigan, or, if liked, roast a bird specially for the purpose, and in this case let it be slightly under-dressed. Cut it into neat joints, and lay these aside until wanted. Wash any fresh salad that may be in season in salted water, and dry it carefully by putting it after it has been washed, a small quantity at a time, into a dry napkin, and then taking this up by the four corners and shaking the moisture from it. Put a layer of the salad at the bottom of a dish, lay the inferior joints of the bird upon it, and cover each piece with sauce. Cover these with the remainder of the salad, and lay the rest of the bird upon it; pour sauce over the whole and serve. The sauce may be made as follows: Beat the yolk of an egg for a minute. Mix with it a large pinch of salt, half a tea-spoonful of powdered sugar, a tea-spoonful of finely minced shallot, and the same of chopped parsley, tarragon, or chervil. Stir in, first in drops and afterwards in tea-spoonfuls, four table-spoonfuls of best salad-oil, and beat the sauce briskly between each addition. Add gradually two table-spoonfuls of chilli vinegar, and set the sauce in a cool place till it is wanted. Before using, mix with it a quarter of a pint of thick cream. The salad should not be arranged upon the dish until just before it is wanted. It may be garnished in any way that fancy dictates. It looks very pretty as follows:—Place a thin flat rim of butter round the dish on which the salad is to be served. Cut four hard-boiled eggs into half-quarters lengthwise, and stick the pieces upon the butter, placing the yolk and the white alternately to the outside. Arrange round the salad, and resting upon the top of the eggs, a sort of trellis-work of beetroot, cut into thin slices. Pour the white sauce over the salad, and sprinkle over it half a dozen parsley-leaves broken into small pieces. Serve as soon as possible after the sauce is poured on. A salad garnished in this way would have to be served on a flat dish, and not in a salad-bowl. Time, half an hour to roast the bird. Sufficient for five or six persons. Probable cost of ptarmigans, 1s. 6d. to 2s. 6d. each."

DR. BROWN'S COUNTRIES OF THE WORLD.

"A Graphic and Popular Description of the Countries of the World." Illustrated. By Robert Brown, M.A., F.R.G.S., Ph. D., F.L.S., late President Royal Physical Society of Edinburgh. Cassell, Petter, and Galpin. London, Paris, and New York.

This serial is a pleasant addition to our geographical works, which will doubtless prove as valuable and successful as many other publication of Messrs. Cassell have. The following will afford sufficient sample of the contents of the work.

The Temperature of the Arctic Regions.

"In Greenland, though the amount of snow is in the winter considerable, and is longer in clearing away near the coast than further south, yet north of 70° the quantity which falls is less than it is outside of the Arctic Circle. The Arctic regions are also by no means the regions of greatest cold. It is even believed—we confess not without some grounds worthy of attention—by some geographers that around the Pole we shall find a comparatively open sea, or at least one not so nearly choked by ice as might be expected from the high north latitude. The waters are frozen, because, as far as we yet know, the greater portion of the northern parts of the globe is occupied by the "Arctic Ocean;" but the cold is so intense in the heart of Asia and of America, that, doubtless, if sea existed in such places, it would be also frozen. The truth is, the Arctic Circle, though unfortunately adopted by some physical geographers as the southern limit of the Arctic region, is in reality in no way a physical boundary of the regions of ice and snow from the regions where the climate is more temperate. It is one of the lines which the astronomers have found it necessary to draw on the globe for their own convenience, and merely expresses, to use their language, a circle drawn round the northern end of the earth, at a distance from the Pole equal to the obliquity of the Ecliptic—or the sun's apparent yearly path among the stars from west to east. For the purposes of the physical, as distinguished from the astronomical, geographer, perhaps the tree-limit would have been the best Arctic Circle; but it is really impossible to confine vague climate and climatic influences with any hard and fast line; and, accordingly, the Arctic Circle of non-astronomical people must be like a "movable feast"—not very settled.

The Arctic Woodland.

"Popular impressions are often far from the truth, and in regard to the Arctic regions they are undoubtedly so. A treeless land would be, in the opinion of most people, the idea which would suggest itself in regard to the regions in question. Yet this, though true, is not all the truth. Within the Arctic Circle are found trees often forming considerable though stunted forests. In Eastern Siberia pines and other trees come down almost to the water's edge; while over all Western Siberia, Arctic Russia, and Lapland, the tree limit runs within the Arctic Circle; trees extend even to the North Cape. In Greenland we find, even in the most southerly parts of it, no herbage more worthy of the name of tree than the stunted birch, which in the more sheltered valleys of that country — equally inappropriately named with Iceland—attain the proportion of little shrubs; and it is not until we come to the milder latitudes of the Pacific that the tree-line, which had described a southerly curve in the cold regions of Central North America, again rises to the north, and until we reach the shores of Behring Strait we find nothing which we can dignify by the name of trees. . . . The wooded banks of the Yuken touch the Arctic Circle, and forests of white spruce are found on the Noatak, a river which falls into Eschscholtz Bay, which infringes on the Arctic Circle. In Lapland the spruce ceases at about the 68th parallel, and the Scotch fir at the 69th; but in Norway, owing probably to the presence of the warm Gulf Stream, which sweeps along the coast and into the Arctic Sea—at least as far east as Novai Zemlai—we find forests of Scotch firs sixty feet in height as far North as Altonfjord, and birches about forty-five feet high in an equally northern latitude. In latitude 70° 28′ the hardy Scotch fir still maintains its ground, though the spruce fails a degree or so further south. In the vicinity of Hammerfest, a well-known Lapland town, in latitude 70¾° N., there are dwarf alders and aspens, bud cherries, rasps, and currants. In the Scandinavian Peninsula, probably also owing to the warmth which a sea, unencumbered, and in addition laved, by a current of a higher temperature, affords, barley is cultivated as far north as the 70th parallel, the latitude of Disco Island, on the Greenland coast, and oats up to the 65th, 'in sheltered valleys, where rocks and cliffs reflect the sun's rays with much power.'"

FOREIGN SCIENCE.

Amongst noteworthy matters in reference to Foreign Science is, the appearance of a book called "Progress of Science and Industry," by M. Henri de Parville, for the fifteenth year (1876). It contains 360 pages, and 50 vignettes, and is published at the Librairie de J. Rothschild, rue des Saint Pères, 13. The editor of *Les Mondes* pays him a great compliment, styling him one of the clearest, most learned, and most complete writers in France. He joins precision of thought to a great elegance of style—a very strong recommendation, we think. We cannot sufficiently recommend lovers of and students in science to cultivate the first with all the earnestness in their power; and their reward will be an immense saving of time, and more intelligible results than are sometimes offered.

Amongst the items of general usefulness which we have space to mention, we include M. Charthain's (4, Rue de Jouy) Gas Moderator which M. Peligot reports to the Committee of Economical Arts of the Society for the Encouragement of National Industry. He shows that it is a good deal more a moderator than a regulator. The principal advantage is that it avoids the fluctuation of light of the burners on lighting or at the times of rough changes of pressure. This is no despicable invention. A six months' trial of this moderator was made, demonstrating an economy of 12 per 100 in the consumption. Our friends across the Channel are far readier than the British in offering money prizes for the development of science and industrial arts. Why cannot our nobility, millionaires, and public authorities, who so often express a desire to advance interests of this kind, systematically bestow prizes for such matters as may be indicated to them by the leading professors of the various arts and sciences? Talk of assisting the development of science in this country, why we might be 1,000 per cent. more forward if this suggestion were acted upon! It appears that the authorities of Calabria have offered a prize of 2,000 francs to any person who shall discover a process for the extraction of the essence of bergamot. The conditions are difficult to fulfil, for it is necessary to find a process not at all expensive, and allowing extracts of the greatest quantity of essence in a short time, and without modifying either purity, colour, or smell. The president of the Society for the Encouragement of National Industry suggests for imitation in the study of geography in schools a plan in relief of the Isthmus of Suez, prepared by Admiral Paris. As we reviewed a very good map and guide to the Canal some months ago by Messrs. Phillips, Fleet-street, we may as well give some particulars. The masses of the ground and rock are made either by moulding or otherwise, and the parts recovered from water painted blue and dried, a plan in relief of this kind may be completed in half a day. The neatness and truth of the smallest details of this plan are remarked upon by the president. There has already been a great sale in France of similar plans in connection with educational establishments. We take it that these plans are somewhat like those which were exhibited at the Mansion House by Mr. Mackenzie, the originator of that North-west expedition in Africa, about the advantage of which some of the literary and scientific papers cavilled.

In geography, which, with magnetic and atmospheric observations, is engaging a great deal of attention in Paris at present, M. Elisé Reclus, the Communist, has brought out the first volume of a new work published by Hachette, Paris, "The Earth and Men"—Southern Europe (Greece, Turkey, Roumania, Servia, Montenegro, Italy, Saint Marins, Malta, Corsica, Spain, Andovre, Gibraltar, Portugal) containing 1,020 pages, with seventy-three engravings, and 175 maps, four of them being coloured. We call attention to the great length to which French works on important subjects have been extended of recent years. Some critics praise the work, and say it is not at all too diffuse, but that he ought to have given the authorities of the documents he reproduces.

PETERSON'S REVOLUTION INDICATOR FOR SHIPS.

THIS instrument, which was introduced to the members of the Inventors' Institute at one of the concluding meetings of the last session, is protected with a round iron case, 11in. in diameter and 19in. in height, whereof one-half can be opened for cleaning, &c., and at the top is a large lubricator to feed all the bearings within. At the base of this case is a small box projecting open from underneath, 7in. long and 4in. wide, with a lubricator and two pulleys, 2in. in diameter and 1½in. wide, acting on a hollow spindle ¾in. diameter, to guide a leather band, 1in. wide, from the main pulley of the instrument forward to the main shaft of the engine, whereon a driving wheel is fixed, 29in. diameter, to actuate the instrument, which is placed about five feet from the said shaft. Two ½in. gas pipes are then connected with the case—the one is conducted through the engine-room on deck, and so forth to the bridge, and the other to the front of the engineer, or where it may be most convenient to read off the revolutions. At these places are two round dial-boxes connected, 6in. diameter and 2in. thick, with glass covers and pointers, indicating on graduated white glass dials, and at the back is provided two lanterns to illuminate the dials at night-time.

The instrument acts like and has somewhat the appearance of a governor without balls. The two plain rods at the top, which are attached to a quill, 1in. diameter, being 9in. across when fully expanded. The other two being each 5in. in length and crossing each other sideway of the quill, when connected with the sliding-weight underneath, which regulates the range for the indication, so that when set in motion, the former commence acting, and the latter so gradually until they are folded up, and thus make a stroke of 8in., divided into 130 parts called revolutions, which are tested by a driving wheel of the same diameter as that fixed on the shaft. Besides this there is a mechanism to enable the instrument to make a steady indication, and not to alter that position before a real change has taken place. This body is revolving on a hollow spindle ¾in. in diameter, placed vertically through the centre of the case, and connected with a fork-piece sliding on a vertical bar and fixed to a chain which works two toothed pulleys, placed about 12in. apart. These pulleys carry another chain, fixed to copper wire and conducted through the pipes to the corresponding wheels in the dial cases, which then indicates the revolutions.

The advantages claimed for this invention are:—1st. That it can indicate the revolutions in three or four different places with one instrument. 2nd. That it can easily be fitted without delay and inconvenience. 3rd. That it can be taken to pieces, repaired, and refitted, with other parts in reserve, by the engineer on board without interfering with the adjustments or its proper indication. 4th. That it is composed of a mechanism which cannot be affected by the temperature in different climates. 5th. That it will be neat, and handy to the officer when fitted up. 6th. That it requires very little attention, which consists of filling the lubricators and cleaning them like the other parts of the machinery. 7th. That it stops and reverses quickly, to indicate when the ship goes astern. 8th. That when the piping has been once fitted and connected with the case, in which the connections with the dials are preserved, it never need be unscrewed. 9th. That the pointers do not make the least vibration, although sensitive to the changes of the speed. 10th. That the instrument cannot be affected when the ship is rolling and pitching.

This invention is patented, and is now quite ready for the manufacturing, with every convenience for being introduced in the Navy and Steam Navigation Companies, abroad as well as in England. The inventor is therefore desirous to exhibit his invention to the public, and, at the same time, desires the assistance of a gentleman with capital who would assist him in the affair.

Those who may be interested to see the instrument at work, can have an opportunity at any time, on application to the inventor, Mr. C. Peterson, engineer, 3, Lime-terrace, New Charlton, S.E.

HANDYSIDE'S STEEP GRADIENT RAILWAY SYSTEM.

AN interesting and valuable series of experiments has just been carried out on the High Peak Railway, of the London and North Western Company, in Derbyshire. The object was to test the practicability of working heavy traffic on steep gradients by Mr. Henry Handyside's method of conducting the traffic up steep inclines by locomotives, instead of by stationary engines. The inventor for many years held the office of Assistant Provincial Engineer to the Government of Nelson, New Zealand. The conditions of the development of this enterprising colony impressed him with the necessity of providing railways at a greatly less cost than is required to construct the even tracts which are insisted on for the main lines of this country, and the first condition cleary was to be able to work the traffic with considerably steeper gradients. Sacrificing the speed of expresses at sixty miles an hour, and being content with a more moderate though still quick rate of transit, and possessing the means of ascending and descending inclines with safety, with slight interruption to the speed of the journey, and without any serious addition to the cost, it is evident that the field of the Locomotive and the Railway might be enormously extended. They might, with these conditions fulfilled, traverse hilly districts, where a gradient of one in 70 or 80 would mean an enormous cost of construction, could profitably be introduced into parts of the country where the trade and the population would not give a dividend on the cost of an ordinary railway, and could particularly be rendered available to convey mineral products as stone, lime, &c., from the mountainous parts of the country, where they are generally found. Our main lines of railway have been made, but the feeders have yet to be constructed; and these wait only for the proof that they can be made at a low cost, on which the smaller traffic would suffice to pay an adequate dividend.

The points above stated are those kept in view by Mr. Handyside, and he deals with them thus:—On each side of the engine-framing is suspended a self-acting gripping strut. These, when pressed by levers, clasp the sides of the rail firmly, and so fix the engine in its position, and render it stationary. The engine is of light construction, which involves a saving in the weight to be moved, and in the weight of rail and general construction of the permanent way; but the essential novelty is the use of an effective brake to give great power in arresting speed in the descent, and particularly in fixing the engine in the ascent, then turning the steam into the cylinders which produce the revolution of the drum, and drawing up the load by the steel wire rope. The new method has been successfully tested by models, and by its practical application in hauling at the Avonmouth Docks, at the latter on a gradient of 1 in 10. But what was needed to prove its complete applicability to railway work was that it should perform the actual traffic of a line of railway.

A specially favourable opportunity for applying this test has been placed at the disposal of the inventor, and his partners in the enterprise, by the courtesy of the London and North-Western Railway Company. They are the proprietors of the High Peak Railway. This, as its name indicates, traverses the summits of the ridge which forms the western watershed of the Derwent and the Wye, and separates their valleys from that of the Dove. It starts from Cromford on the right bank of the Derwent, not far from Amber-gate. It rises to the foot of the Black Rock by a gradient of 1 in 8, and passing over the road from Wirksworth to Cromford again ascends an incline to Middleton of 1 in 10. It proceeds from that point on the level, to the foot of the Hopton incline, which is a quarter of a mile long, and has a gradient of 1 in 14. Thence there is a long stretch of twelve miles on the summit of the hills to the incline at Shallcross, which has a gradient of 1 in 10 or 11. The line joins the North-

Western Railway proper beyond Buxton. This is one of the oldest railways in the kingdom, having been constructed in 1826 as a horse tramway, but has for some years been worked by locomotives, with stationary engines for the inclines. In addition to the main line there are several sidings. The line is single, and does not carry passengers, the principal freights being limestone, the fine Hopton paving stone got near Wirksworth, and other building stones. The traffic on the line is considerable, though it is not regarded as a profitable part of the London and North-Western system.

The incline chosen to test the power of Mr. Handyside's system is that at Hopton, at the head of the famous Via Gellia, and recently, as we are informed, in the columns of the *Derby Reporter*, from which we have already quoted, the engine took a train of 27 loaded trucks, weighing 280 tons, from the top of the Hopton incline to Hurdlow, a distance of 12 miles, stopping at five places and shunting on the way. It traversed the distance in two hours 53 minutes, consuming 500 gallons of water and 5 cwt. of coal. It took 12 waggons, 10 of which were loaded, with a total weight of 120 tons, up the incline at Hurdlow, which is a mile and three quarters long, and has a gradient of 1 in 60, and made the ascent easily without the rope. It descended the incline and got back to Hopton in three hours fifty-five minutes from the time it had started from the latter place. It was then supplied with water, went down the incline, fetched up seven loaded waggons in two draws, waited for the down train and took that train of nine waggons, weighing 90 tons, at once down the incline and on to Middleton.

We have stated the facts with as little comment as possible, and they go far to prove that Mr. Handyside has shown the railway world how to construct cheap railways, and he is hardly extravagant in stating that with his mode of traversing inclines railways may be made in any part of the country at four thousand pounds a mile. If that be so, the area of steam locomotion may be indefinitely extended, and the traffic on the main lines increased by the construction of numerous feeders across districts which would not pay for an expensive, even-graded line.

This method of ascending and descending inclines may prove of great advantage in warlike operations, and the War Office so thoroughly appreciates the importance of the experiments that the Royal Engineer Committee on Field Railways will visit Hopton to report on the system early next month.

THE IRON AND STEEL INSTITUTE.

At the meeting at Leeds on 21st September, Mr. Snelus explained by means of diagrams the method adopted by him for steel making purposes at the West Cumberland Ironworks, and which had proved highly successful. The arrangement consists of a ladle, placed in a carriage fitted with springs and running on two pair of wheels, the centre of gravity being kept low. Rails are laid down from the blast furnaces to the Bessemer converters, and the metal is tapped into the ladle and run to the converters, into which it is tipped, and the carriage with its ladle run back. Mr. Snelus has three of these carriages, and the cost of them was about £1,000. The iron is run into the ladle from the furnace and tipped into the converter in five hours from the time of tapping. The result was an increased yield of steel, showing a considerable saving as against the previous plan of runners.

Mr. J. T. Smith, of Barrow, observed the direct process was carried out at the Barrow works, and was most successful. They obtained a better class of steel than when they melted the pigs in the cupola.

Mr. E. W. Richards, by means of a model, explained the means of conveying the molten metal from the furnaces to the converters now being carried out at the works of Messrs. Bolckow, Vaughan, and Co. The metal is tapped into ladles, carried on wheels, and is run on rails to the converters. The ladle carriage is then raised by a hydraulic lift to the converter, and the metal is poured into them instead of through runners, as on the ordinary plan.

In reply to Mr. Williams, Mr. Snelus stated that the surplus made of cold iron produced on Sundays was used in the Bessimer pit, which had not yet been fitted with the direct appliances.

The president, Mr. Menelaus, observed that Mr. Snelus's arrangement was a very good one. He further stated that they were working the direct process at the Dowlais Works with complete success. The Sunday iron was a difficulty which he feared they would only be able to overcome by working the converters on that day as blast furnaces were worked.

A paper was read by Mr. J. O. Butler, of the Kirkstall Forge, on the hydraulic forging and stamping of malleable iron on the system of Haswell of Vienna. In commencing his paper the author observed that the forging and shaping of iron had been practised in very remote times and with very simple appliances. In later times the manipulation of malleable iron when in an incandescent state into shapes of almost endless variety had been greatly stimulated by the ever-varying requirements of the practical engineer. The rapid strides made in the operations to which allusion had been made were due almost entirely to the steam hammer. The pressing of the iron into a mould of the matrix to give shape to various articles by the aid of the screw press had also been practised for many years. The steam hammer had likewise been brought into requisition for the same purpose, but to a limited extent only. Mr. Haswell, of Vienna, was the first to bring into practical and useful operation the "squeezing" of malleable iron at a welding heat into "shapes" and "uses," as they are technically called, previous to their being manipulated by the smith and fitter. The tool which Mr. Haswell has produced for that purpose is simply the adaptation of the hydraulic press on the principle of Bramah with an arrangement peculiar to Haswell, whereby a "squeeze" can be given without reciprocating, all in one continuous thrust, until the piece operated upon acquires the desired shape. The pumps are worked by a horizontal direct-acting steam cylinder of large size, the working of which is directed by an automatical arrangement, so that it is perfectly and instantaneously under the control of the driver. The metal is squeezed or forced under heavy pressure into a mould of the required form. No expensive foundations are required as both the engine and pressure are self-contained.

Mr. J. T. Smith, Mr. Greig, Mr. A. E. Cowper, Mr. Price Williams, Mr. E. H. Carbutt, and Mr. F. A. Paget spoke as to the importance of this system.

Sir Joseph Whitworth described his system of casting fluid steel under pressure, observing that it was compressed one-eight of its length in five minutes, all the gases being expelled. His firm had recently made two screw shafts for the Inflexible of fluid compressed steel.

The meeting passed a vote of thanks to the author of the paper.

The next paper was read by Mr. E. Butler, of Kirkstall Forge, on "The Straightening and Planishing of Round Bars," as practised by patent machines at Kirkstall Forge. The author observed that, in spite of all the care and skill exercised in the rolling mill, the ordinary round bar left it a somewhat imperfect cylinder, neither truly round nor truly straight. It was a comparatively easy matter to straighten a bar bent in one uniform curve from end to end, but the short bends, crooks, or dog-legs were the main difficulty, the presence or absence of which made a bad or good round bar, and these, which proved to be more or less inevitable in all rolling, could only be effectually removed while the bars were still hot, for with cold straightening there was always a tendency in the bars to revert to their original form when the skin was removed in the lathe. The production of a machine to accomplish the desiderata in question had long occupied the the attention and taxed the ingenuity of the ironmaster. The original idea, of which this machine is an embodiment, is due to Mr. James Robertson, of Glasgow, though the same idea seems to have occurred almost simultaneously to Mr. G. W. Dyson, of Sheffield. It is the general arrangement of the latter which has been adopted, though many improvements and additions have been made which have given it the success it has now attained. The bars are passed while hot from rolling between two revolving discs having bevelled faces, which when brought together so as to compress the bars between them with the degree of force thought necessary, rotate them, and, at the same time, traverse them forwards, also, by a mechanical arrangement, backwards, so that the whole length of the bar is acted on by one continuous movement, and the bars come out straight and planished. In doing this, moreover, two other important results are produced, the most palpable of which is that the scale, instead of being rolled in, is entirely removed, and the surface is made smooth. The skin is brought to a very high degree of cleanness and smoothness so that a mere rubbing with emery cloth polishes it as though it had been turned and polished in the ordinary manner. The other effect of the machine before referred to, and that a very important one, is that by the action of the discs the bars are slightly compressed and consequently strengthened.

There was no discussion on this paper, and the President moved a vote of thanks to the author.

The final paper was one on the utilization of blast furnace slag with its heat for the manufacture of glass, by Mr. Bashley Britten. In opening his paper the author observed that there was no novelty in the idea of employing slag as an ingredient for glass. It had long been so used in this country, and to some extent on a larger scale abroad. In the Forest of Dean persons were employed about the old charcoal iron cinder heaps, to collect the more vitreous looking pieces, which were supposed to be the only suitable portions, and they were put under stamp heads and pulverized in water. The resulting sand was then dried and sent to the glassmakers of Bristol, who mixed it with their other materials and melted them together. This practice is, however, fast becoming obsolete, because it is found that the cost of preparation and transport, and the very intense heat required to forge slag which has once cooled, leaves no advantage from its employment instead of other materials. A few years ago the price paid for this slag sand, delivered at Bristol, was as much as 20s. per ton, and this in 1875 had dwindled down to 12s. 6d., which was said to be scarcely remunerative. The theory of the manufacture is that by combining with 100 parts of slag 10 parts of soda and 65 of sand, the proportion of the lime, alumina, and other constituents are severally altered, and a compound formed of the precise nature required. As regards the practice, Mr. Britten observed that blast furnaces where pig iron only is made frequently stand in pairs, with plenty of space around on which glass works may be erected, and in many instances they might be built close up to the sides of the furnaces. In that case the slag might be run directly into a glass furnace on the well-known plan of Dr. Siemens for continuous founding and working. Where there is sufficient room for this the glassworks might be at some distance, and the slag could be collected and conveyed to them in a state of fusion in covered iron ladles on wheels, similar to those used in Bessemer Steel Works. Mr. Britten has experimented in making slag glass for three years past with success, specimens of the products being exhibited to the meeting. The glass has a green tint.

In the discussion Mr. Pattinson, Mr. Snelus, Mr. E. A. Cowper, and Mr. Britten took part.

The President, in conveying a vote of thanks to Mr. Britten for his paper, observed that many years since Sir John Guest put up slag glass works, but, as he did not use the slag hot, it failed. Later on, an American gentleman started a slag glass manufactory, but only spent a large amount of time and money and then failed.

The President proposed a resolution conveying the thanks of the Iron and Steel Institute to the president of the Reception Committee, Mr. F. W. Kitson, and the two local secretaries, Mr. J. Whitham and Mr. J. Barber, the latter of whom has been especially untiring in his exertions to promote the success of the meeting. The vote of thanks also included the Mayor of Leeds and those gentlemen whose works had been thrown open to the members. The vote was most warmly accorded by the members.

The question of the visit to Sweden next year was discussed, and it was resolved that the opinion of all members should be ascertained by circular.

Mr. Samuelson, M.P., then moved, and Mr. J. T. Smith seconded a vote of thanks to Mr. Menelaus, the retiring President, which was heartily accorded, and feelingly acknowledged by Mr. Menelaus. The members then adjourned to luncheon in the Victoria Hall, a performance on the grand organ being again given by Dr. Sparks.

After luncheon the members proceeded to visit the Lowmoor Ironworks, the Bowling Ironworks, and the Fire-brick and Sanitary Tube Works of Messrs. Joseph Cliff and Sons and W. Ingham and Sons at Wortley. These visits occupied the afternoon.

GOEDICKE'S SEWAGE SYSTEM.

This new scheme consists in the distribution of sewage without or after disinfection to consumers (farmers, market gardeners, chemical manufacturers), etc., in different localities, by the same water which carries the sewage to one or more outlets.

The distribution is accomplished by pipes, covered channels, or sewers, from which branches are in connection with the places for utilization. Each consumer must have either a cistern with two conpartments, or at least two tanks, so placed and fitted that one retains the solids, the other the liquids. The solids to be carted away, the liquids to run either direct on to land by perforated pipes or otherwise, or distributed by water-carts, at the option of the consumer. The supply of sewage is either at stated times or continual, or as the consumer may require it, in a similar way as the water companies supply their water for consumption. The value of the sewage is estimated either by contract, or by the rateable value of the land supplied. The supervision by a proper authority will prevent any nuisance.

The advantages claimed for this new scheme of sewage disposal are as follow:—1. It can be carried out by any local authority or company after simply advertising for tenders for the sewage. 2. It makes sewage at once of market value, and with a very much less preliminary expense than the purchase of a sewage farm would be, and it can be adopted in any parish, however situated. 3. The expense of disinfection can be altogether avoided. 4. To meet the different levels, not one, but different outfalls may be arranged. 5. The same water which carries the sewage to one or more outfalls will carry it to its destination for utilization. 6. In localities where the liquids are too large, the superficial drainage (rainwater) could be diverted from the outlet, and being unimpregnated with sewage, be carried in any watercourse. 7. On suitable outfalls and localities the solids may be separated at once by a strainer or otherwise, and carted away, and the liquids distributed by pipes to land, or chemical works.

The originator of this system is Mr. W. E. R. Goedicke, Medical Officer to the West Ham Sanitary Board.

AMERICAN INVENTIONS.

Tile-Laying Mole Plough.—Stephen H. Reynolds, Hillsborough, Ind.—This relates to the construction and arrangement of a lever for laying and adjusting the drain tiles or tile sections, and the means for adjusting the pitch of the furrow tube and regulating the depth of the furrow. The implement lays the tiles without opening a permanent ditch.

Sulky Plow and Cultivator.—Eli. W. Russell and John N. Russell, Ashley, Mo.—This machine may be readily adjusted for use as a plough or as a cultivator. The plough is free to turn upon the axle, while a collar keeps it from lateral movement upon said axle. By adjusting the collar, the plough may be adjusted to cut a wider or a narrower furrow, as may be desired.

Self-Discharing Manure Spreader.—Thos. A. McDonald, Durham, Nova Scotia, Canada.—This consists of a waggon for transporting manure and spreading it broadcast or in drills. The bottom of the waggon is in the nature of an endless travelling belt, or apron, supported upon polygonal shafts, one of which is geared with, and derives motion from, the rear axle. The latter is provided with a spring clutch mechanism, by which it may be thrown into and out of gear with the endless apron at the will of the driver, in order to thus regulate the discharge of the manure. The means immediately employed to throw the clutch out of engagement are pivoted levers, operated by connecting rods and a lever under control of the driver. The manure is dischaged from the end of the waggon by the endless apron, and broken up or pulverized by a toothed roller.

Combined Plow and Cultivator.—Charles Frank, Freeburg, Ill.—This embodies several new mechanical devices whereby the machine may be readily adjusted for use as a plow or as a cultivator, and which can be conveniently manipulated. These devices enable the frame to be raised or lowered so that the ploughs may work at any depth, allow of the plows and cultivators to be easily attached or detached, and permit of the tongue being adjustably secured to the frame.

Revolving Harrow and Pulverizer.—Thomas A. Kershner, Seymour, assignor to himself and Alexander Carr, Medora, Ind.—The new feature consists in the teeth made with curved forward edges, concaved rear edges, and broad heads pointed to the rearward, in combination with a rotating cylinder.

Harrow.—James Elliott, Jefferson, Wis.—This consists of a number of toothed harrow sections that are connected by pivoted side pieces, and made to slant by slotted angular braces and clamped bolts. The harrow sections are coupled laterally by interlocking hook devices.

Cultivator.—Daniel F. Vickery, Oxford, Ala.—This invention is an improvement in that class of walking cultivators whose shares or teeth are made adjustable toward and from each other laterally. The improvement relates particularly to the construction and arrangement of parts whereby the shares or teeth are made laterally adjustable, separately or together, without changing their relation to the line of draft. The teeth are attached to a horizontal bar pivoted to the beam and provided with curved braces for regulating its adjustment.

Boot and Shoe.—David J. Rogers, Bardstown, Ky.—This invention is an improvement in the class of boots and shoes provided with wooden soles, and relates particularly to the mode of securing the wooden heel, and also the rear edge of the wooden sole, to the leather sole, by screws, in such a manner that the screws are concealed and prevented from tearing out of or wearing the sole.

Fountain Pen.—Henry N. Hamilton, White Plains, N.Y.—The lower end of a tube, which serves as a socket to receive the handle, is halved and closed with a plate, which is extended into a tongue. The lower part of the tongue fits into the hollow of an ordinary pen, and forms a chamber to receive and hold the ink. The tongue is perforated with numerous holes, into which the ink enters, so that the ink may be partly supported by capillary attraction, and thus rendered less liable to run out too rapidly. The pen may be readily removed from and inserted in the holder by sliding down a ring,

Faucet.—Minrad Obermiller, Toledo, Ohio.—This relates to a pump attached to a faucet, contrived in such a manner that when the faucet is opened it forces air into the barrel, either through the faucet or a tap fitted in the barrel.

Artificial Teeth.—Merrick Bemis, New London, Conn.—The object of this invention is to furnish sets of teeth for eating purposes for those whose front teeth remain good, which will enable them to thoroughly masticate their food, and, at the same time, will avoid the necessity of having the remaining teeth drawn. It consists in artificial teeth in which the plates are formed to fit over the natural teeth, and in which the teeth are all molars, and are arranged with the longer side inward.

Whiffletree Hook.—Peter P. Kunz, Florence, Iowa.—The furrule is cast with a solid outer end, and upon its forward side is a hook arm, in the cavity of which rests the end of a bar. The bar is bent at right angles, and its other arm passes through a hole in the furrule at the end of the whiffletree. Upon the bar, within the cavity of the ferrule, is placed a spiral spring, by which it is pressed forward against the hook, so that the tug or cock eye placed upon the said bar cannot become accidently detached. The tug is attached and detached by pressing the bar to the rearward and turning its free end upward.

Saw Gummer.—Jason W. Mixter, Templeton, Mass.—This consists in improvements in saw gumming machines so that they may be readily set to any angle of cutting in connection with a feed that may be controlled either automatically or by hand, as desired.

Wooden Hoop Fastening.—Wilbur J. Squire, East Haddam, Conn.—This consists in a wooden hoop having its ends locked by a band drawn into a notch at each end. It seems to be a very simple and useful device.

Machine for Boring Fence Posts.—John Dickens, Kingston, N.J., assignor to himself and George R. Kelly, same place.—The novel feature in this is found in the carriage, which is secured in place by a clamp bar, through the centre of which a screw passes, and is swivelled to the table, and has a hand wheel attached to its lower end, below the said table. The clamp bar moves up and down upon guide pins, and upon its under side are formed points, which enter holes in the bars of the carriage to centre said carriage when adjusting it.

Washing Machine.—Franzis M. Marstrom, Lawrence, Kan.—The rubbing surface of the suds box is formed by attaching half round strips of wood at their ends to strips of zinc. The moveable rubber is formed by attaching half-round strips of wood to the curved edges of segmental disks. When the levers are arranged in a vertical position their ends rest against cleats attached to disks of the moveable rubber, against which they are locked by catches, so that the rubber will be operated by operating the levers.

Heating Attachment for Stoves.—Lars M. Madson, Daneville, Dak. Ter.—This is an improved heating attachment to cooking and heating stoves, by which the heat of the fire gases is more completely utilized before escaping into the chimney. It consists of a sectional pipe made of jointed elbows at suitable inclination, and supported on the stove and on an adjustable brace standard.

Mechanical Movement. — Miner G. Mosher, Wichita, Kas.—This is an improved device for converting a reciprocating into a rotary motion which has no dead points. It mainly consists in the combination of a U fork, provided with two pairs of hook pawls, with the wheel provided with the bolts; and in the combination of the three three-armed or T bars and their connecting rods or chains with the U bar or fork and with the two sets of hook pawls.

Steering Propeller.—Flavius J. Ashburn, West Union, W. Va.—This consists of propeller blades arranged horizontally on and hinged to vertical crank shafts suspended from a horizontally revolving frame above the water, and connected by their cranks to the crank of a shaft in the centre of the carrying frame, and around which they swing. All the paddles thus face in the same direction, so that in the forward motion they turn upon a hinge and work edgewise, and in the back motion they work broadside against the water to propel the boat. This invention also consists of a stationary crank around which the bucket swings, made to be turned in either way, and provided with means for turning it, which may work either by the engine or by the pilot wheel, whereby the direction in which the paddles act is changed at will to reverse the motion of the boat, and to utilize the propeller for steering it.

Method of Annealing Plough Mould Boards.—Eli H. Babcock and John C. Whiting, Canandaigua, N.Y.—The object of this invention is to enable chilled mould boards and other chilled castings to be cooled without warping or being strained, and thus keep them in exactly the required shape. It consists in removing the castings from the chills as soon as they are cool enough to be handled, placing them in hot forms, and cooling them under pressure, and under a gradually diminishing heat.

Metallic Girder.—John L. Nostrand, Brooklyn, E. D., N.Y.—In the neck of the head or flange is formed a longitudinal groove or channel, to receive the edge of the web, where it is secured in place by bolts or rivets. By this construction, beams of a greater strength can be made by using the same quantity of iron, or of an equal strength, by using a less quantity of iron, and also, the strain is transferred from the rivets to the shoulders of the heads, against which the edges of the web rest.

Watchmen's Time Detecter. — Jacob H. Massey, Allentown, Pa. — This is a watchman's time detecter, which is applicable to a building for inside and outside use. It consists of a dial with concentric circles, revolved by a clock train, and operated by a suitable spring-marking device, in connection with a pull from the inside or outside of the building. The marking device is set for each day by a crank shaft engaging a rack of the marker.

Vibrating Propeller. — John Forgie, sen., and John B. Forgie, jun., Hicksville, N.Y.—This invention consists of carrying paddles in the form of the slates of a window blind, and working alternately sidewise and edgewise to the water as the frames swing backward and forward. The said frames are pivoted at the upper end in such a manner that the lower end works parallel with the engine rod, to which it is connected, to be worked by the steam power applied directly to the rod.

Double Acting Force Pump.—George W. Hooper, Greene, Me.—In using the pump, as the piston moves downward, a vacuum is formed above it, and the water is forced by atmospheric pressure, through passages and a valve, and passes into the upper part of the cylinder. At the same time the water in the lower part of the cylinder is forced out, opening another valve, and passes into the pump tube and out through it. As the piston moves upward, and the water passes in through other openings and valves, and passes into the lower part of the cylinder. At the same the water above the piston is forced into the pump tube.

Valve Gear.—John E. Giles, Hazleton, Pa.—The crank pin which works the valve is carried in a block in a slotted disk which slides along the disk for shifting the valves, and to the opposite side of the axis for reversing, and is worked by a sleeve on the shaft of the disk to which the shafting lever is connected. The disk is geared by a toothed rim with a wheel on the crank shaft (which gears are eccentric), by which the irregularities of the crank are overcome. For a lap valve, the slot in the disk for carrying the crank pin is arranged out of the centre of the line of the axis of the disk to just the measurement of the lap and lead of one end of the valve.

Barrel for Watch Springs.—Sherman D. Johnson, East Haddam, Conn.—This invention consists of the combination of the mainspring barrel by suitable pawls with a separate toothed wheel around the barrel, that is capable of motion independent of the rim on the breaking of the spring.

Furnace for Burning Sawdust, Tan Bark, &c.—Frederic T. Kidder, Claremont, N.H.—This invention consists in using feeders under or in the bottom of the mass of the fine fuel, with which the stove is filled. The said feeders are pieces of wood extending from the front at the draft inlet along the stove to the back, and which, being ignited at the front end, burn slowly, together with the sawdust or tan bark immediately around them, while the heat, ascending up the bank of other fuel, converts it into charcoal, and prepares it for burning as it falls down to the fire. In case the fine material is very wet, perforated pipes are placed horizontally in the same, a little above the wood pieces, to conduct some of the heat into the mass, for drying it in advance of the fire, by passing from the tubes up through the fuel.

Lubricator.—Simon Smith and Isaac S. Collins, Mauch Chunk, Pa.—This is a horizontally feeling oil cup for parts of steam engines, which can be regulated to feed a greater or less quantity of oil when the engine is in motion, but which discontinues the oil suply when the engine is stopped. It consists of a horizontal cup of cylindrical shape, with tightly seated glass head. The feeding mechanism consists of a horizontal reciprocating pin, guided in suitable manner, and having recesses that take up the oil from supply perforations and convey it to the feed tube at each oscillation of the part of the engine to which the lubricator is attached.

Leather Tapering Machine. — John Settle, Lebanon, Oregon, and George W. Settle, Oakland, Oregon.—This invention relates to certain improvements upon the patent granted the same inventors, January 19th, 1875, for a machine for tapering leather, in which a pivoted frame carrying a knife moves over a hinged adjustable curved block to taper the end of a strap, belt, or other piece of leather, preparatory to attaching the same to another piece, and it consists in the construction and arrangement of a device for clamping and holding the piece of leather in a convenient and effective manner.

Tweer.—Mark Lester, Bellaire, Ohio.—The object of this invention is to prevent the accumulation of sediment in the annular water space of a tweer for blast furnaces, and to prolong the life and utility of the latter. To this end the invention consists in providing the overflow pipe of the tweer with an outlet cock, located near the bottom of the water space, through which the mud and sediment may be washed out, and extending the supply pipe to the nose or hottest part of the tweer, whereby the cold water is first brought in contact with the part of the tweer which most needs the cooling effect, and whereby also the accumulated mud and sediment may be readily washed out by the natural passage of the water.

Paper Bag Fastenings. — Henry S. Gillette, New Preston, Conn.—A string of suitable length and strength is attached to the bag by means of a piece of paper which is pasted to the bag over the string. This little clip of paper secures the string permanently, so that the clerk need waste no time in seeking for a string to tie the bag.

Improved Awning.—Anthony Hessells, New York city.—This consists of a swinging stretching frame and outer curtain, that is wound up by a roller and cord. The roller is supported on a second swinging frame, to be lowered and adjusted to any position for regulating the height. When the awning is is lowered entirely, it serves to close the window like a curtain, forming a protection against heavy rain, hail, &c.

Improved Cigar Box. — Simon Hood, New York city.—This cigar box admits the convenient arranging of the cigars in bundles, the exhibiting of the same, and the ready taking out for selling them. The body is made of diagonally tapering shape, with steps and guard strips, and is closed by hinged side and front parts and lid.

Improved Pile Saw.—David Bean, Le Sueur, Minn.—This consists of a standard for supporting the saw frame, with a clamping device for attaching it to the upper end of the pile to be sawed off under water. There is also a vertically adjustable arm, on which the frame swings, and on which arm the frame is adjustable to feed the saw up to the pile as the work progresses, and to measure its depth in the water.

Billiard Table Leveler.—Samuel May, Toronto, Ontario, Canada.—This consists of a long nut, with an enlarged head at the lower end, screwing on a rod projecting from the bottom of a socket in the end of the leg, in which the nut works so as to conceal the screw rod. Said rod is either a short one, screwing into the leg at the bottom of the socket, or it is formed on the rod used to screw the leg to the table. In both cases it has a collar screwing against the bottom of the socket, and is secured by wood screws screwing into the wood through notches in the edges of the collar.

Whiffletree Connection.—George W Ingersoll and Harvey L. Fisher, Toledo, Iowa.—This consists in an inclined whiffletree coupling, composed of two unequal bars connected by an eye bar. The inclination of the coupling causes either end of the whiffletree that may swing back to pass above or below the double tree, according as the longer arm is placed above or below the shorter arm, so that there can be no rubbing and wear between said double tree and whiffletree.

Bed Spring.—John Reardon, New York City, assignor to Orville D. Lovell and Frank H. Lovell, of same place.—This is a bed bottom spring formed of a rabbeted U-frame, a flanged crosshead, a guide pin, and a spiral spring, constructed and arranged so that the bedstead can be put up, taken down, and carried from place to place with as much ease as if the slats rested upon cleats, and the various parts of the spring are so arranged that they cannot cut or injure the mattress.

Carpet Stretcher.—Lewis W. Rivers, Salt Lake City, Utah Ter., assignor to himself and Hanson J. Rivers, of same place.—In using the device, the carpet is placed between jaws, and a lever is arranged with its sharp lower end resting upon the floor, and its upper part inclining forward over a bar. The upper end of the lever is then forced back or from the carpet, which draws the said carpet to its place. When the carpet has been strained sufficiently, a pawl holds the lever in place until the stay tacks can be driven.

Feeder for Carding Machines.—William C. Bramwell, Terre Haute, Ind., assignor to himself and Edwin Ellis, of the same place.—The invention consists of a tilting scale for weighing the wool deposited upon it by a toothed travelling apron, the two (scales and apron) being so connected by a clutch mechanism that the apron is stopped intermittingly, thus shutting off further supply until the scale has deposited or discharged the wool which it already contains. The wool having been thus deposited on the feed table, and the scale returned to its original position, and while the elevating apron is delivering a fresh supply to the scale, a loosely pivoted rotating scraper is at work removing the pile of wool just dropped by the scale, and pressing it up to the edge of that which has already been fed on and is about to enter the feed rolls of the carding engine. By this operation the wool is removed out of the way, and a clear place given to the next lot, so that it may not, by piling up, obstruct the proper action of the tilting pan of the scale, and that all the wool may be dropped each time. The tilting and emptying out of the wool from the scale is entirely independent of the time it may take the scale to turn its balance, as this time is constantly varying. It is by this means that the apparatus is caused to run itself out of wool when desired, and yet keep the work even to the last.

Fertilizer Distributor.—David C. Brown, Log Town, La.—This is a device for attachment to the rear end of a waggon body for distributing cotton seed as a fertilizer. It may be used for distributing other fertilizers, and which will enable the material to be placed wherever desired. In using the device, a man is placed in the waggon to keep the hopper filled with the fertilizer. The amount of fertilizer distributed may be regulated by increasing or diminishing the number of pins which feed out the material, and by varying the relative size of the driving pulleys.

Harrow.—William C. Moore, Cairo, Pa.—This is formed in three sections hinged to each other by bolts and straps. The middle section is made rectangular, and the side sections oblique, having their forward corners bevelled off. Shoes are attached to the forward sides of the front cross bars.

Burglar Alarm.—John S. Mace, Chillicothe, O.—This invention belongs to that class of burglar alarms in which an alarm is sounded upon a bell by a hammer, set in motion by a clock spring and spur gear by the opening of the door or window to which it may be applied. The improvement consists in the particular construction and arrangement of a pivoted stop rod with slide spring, and locking devices whereby the alarm is rendered more reliable in its operation, and readily set and adjusted either to give an alarm or not, as may be desired.

Thumb Latch for Doors.—Henry C. Hill, Norristown, Pa.—The thumb lever is pivoted to lugs on the fulcrum plate, which is attached to the door, and the lower part of which is so formed as to fit over the upper end of the upper lug piece of the handle, so that they both may be secured by the same screw. The handle is made with a bend or offset, to enable it to be placed sufficiently near the edge of the door to operate the latch, and leave space for the hand between the handle and the door casing.

The Patent-office Report.—The Patent-office Report shows the usual steady increase in the number of applications for patents during the year with which it deals. In 1875 there were no less than 4,561 applications, or 69 more than in 1874. The growth, however, is smaller than that of the year before, for 1874 exceeded 1873 by 198. The lessened increase is attributed to the somewhat depressed state of many industries. It is calculated that of all the patents granted only 28 per cent. survive their third year, and only 10 per cent. their seventh. 1,173, or more than a quarter of the applications in 1875, are already dead, never having got beyond their six months of provisional protection. During the year a profit was obtained of £110,950, after payment of all costs and charges, including the sums of £24,000 for paper and printing, £18,000 for salaries and office expenses, &c. Last year this income amounted to £110,618. Since the establishment of the office on its present footing in 1852 it has produced over a million of money, the exact sum being £1,229,772. The number of printed specifications, down to the end of 1875, is 95,791, of which 14,359 were filed before 1852. Beyond the above statistics, the report contains nothing new. It is embellished with the usual map of a proposed site for a new office on the Embankment, which has formed part of the report for the last eighteen years.

Australian Silk.—Some interest, says the *Australian and New Zealand Gazette*, has been excited by the exhibition in the window of a Melbourne draper of articles of clothing manufactured from Australian-grown silk. The articles consisted of a pair of socks, made at the Australian Silk Growers' Depot, Charles-street, Grosvenor-square, London; and a lady's scarf made by Messrs. Potts, Wright, and Co., Macclesfield. The raw silk from which these things were made was taken to Europe by Mrs. Bladen Neill, in December, 1875. There is also a skein of carded and spun silk from the mills of Mr. Brocklehurst, Macclesfield. The experts who have examined these articles report very favourably on their quality, and say that Australian silk is considered by manufacturers to be much superior to Italian or Chinese silk. It is therefore expected that silk-growing will become a most important industry in the Australian colonies.

APPLICATIONS FOR LETTERS PATENT.

(*Continued from page* 142.)

On May 24th.—2183 to 2197.—C. H. Roeckner. Means and apparatus for evaporating liquids and generating steam, and for utilizing and disposing of noxious gases.—W. P. Thompson. Cartouch, case, or portable arrangement of materials for dressing wounds (com.)—L. J. Roucou. Liquid compound or composition for bronzing copper, brass, zinc, and other metals, and for preventing the discolouring of gold, silver, and other metals.—H. Woodward. Vulcanite billiard balls (com.)—C. E. Herbert. Organ.—J. Jewett and J. Sergeant. Machinery for combing wool.—C. J. Copeland. Rock-drilling machines (com.)—R. H. Padbury. Sewing machines.—W. Clark and J. Clark. Method of constructing pistons or similar disc bodies.—W. Cochrane. Surveying instruments, which renders the said instruments self-recording and dispenses with the use or employment of a protractor in plotting the surveys.—H. Codd. Closing bottles used for containing aërated liquids.—F. Wirth. Roller skates (com.)—J. J. Fitzgerald. Combined writing case and desk. G. H. Mesnard, W. Sankey, and F. Wilson. Construction of roller skates.—A. M. Clark. Harvesters (com.)

On May 25th.—2198 to 2214.—J. Walder. Roller skates.—T. Lees. Apparatus for curling the brims of hats.—J. B. Thompson. Smokeless furnaces and stoves.—A. H. Mure. Vent pegs—J. Welch. Machinery for doubling and twisting all kinds of cable laid and other cords by regulating the drag or tension in all cases where inverted flyers are used.—W. Whitehead, J. Bolt, and W. Weeder. Table or dessert spoons.—F. Young. Roller or wheel skates.—I. Ahronsberg. Stopping of railway trains and to prevent collisions.—T. Houghton. Machinery for spinning and doubling cotton and other fibrous materials.—W. R. Lake. Implements for cutting pipes (com.) (Complete specification.(—W. W. Dunn. Machinery for drilling, perforating, or boring rocks and other hard subsubstances.—J. Cheshire. Rink and other skates, and the rollers or wheels connected with the same.—W. Turner. Means or apparatus for checking the receipt of monies in bars and other places.—L. N. Loeb. "Stanley" and other scarves (com.)—A. M. Clark. Machinery for rifling fire-arms and ordnance (com.)—A. M. Clark. Furniture castors, applicable also to roller skates com.)—R. E. Cox. Removing sheets of paper singly from a pile of sheets, and feeding them to printing or other machines, or for other purposes.

On May 26th.—2215 to 2226.—C. T. Marzetti. Apparatus for bottling wines, spirits, beer, and other liquids.—A. McLaren. Stable fittings and other similar purposes. A. Arnaud. Thief detector and fire-alarm.—H. Bezer. Means or apparatus for recording the passage of vehicles over given places. R. M. Marchant. Pumps and condensers for motive-power engines, and other purposes.—J. Reid. Construction of plugs or "shives" for casks, barrels, or other vessels, also applicable to union joints for connecting pipes.—P. M. Crane. Manufacture of lubricating oils.—J. H. Sanders and S. Sanders. Puddling furnaces (com.)—T. Preece, G. Preece, and H. Preece. Corn and seed drill.—R. Hammond. Manufacture of balls to be used for the game of lawn tennis.—J. Mawson. Machines for drilling or boring rocks and stone.—J. A. Walkington. Roller skates.

On May 27th.—2227 to 2244.—A. C. Bagot. "Clinometer" instruments.—S. Turner. Machinery or apparatus for making bricks or other articles of a plaistic nature.—E. Yeo. Treatment of yarns for packing purposes.—G. Spencer and E. S. Stidolph. Bearing springs for carriages, trucks, and locomotive engines for railway, tramway, and common roads.—F. Smith and J. Smith. Writing desks or tables (com.)—W. Walker and J. C. Walker. Machinery or apparatus employed in the manufacture of pins and needles, also of cards and hackle teeth.—M. Kennedy and J. Eastwood. Rock-drilling machinery.—J. Kemp. Apparatus for screening or sifting gravel, coals, cinders, or other materials.—T. T. Lawden and J. Thomas. Breech-loading small-arms.—W. Martin. Method of obtaining motive power.—J. Simpson. Steam engines.—L. Razkazoff. Apparatus for absorbing the recoil of ordnance.—W. Bull. Envelopes (com.)—W. Dennis. Apparatus and pumps for forcing and discharging water, air, and other fluids and gases for extinguishing fires, and for other useful purposes.—A. Brown. Stone-breaking machine (com.)—E. T. Smith. Roller skates.—G. Butler. Valves or cocks.—W. L. Wise. Apparatus for exhausting and condensing the spent steam from steam engines, and for other purposes requiring an approximate or a partial vacuum (com.)

On May 29th.—2245 to 2251.—A. Craig. Steam and other engines.—H. Stern. Trimming hats, and the machinery employed therein.—W. Andrews. Cleaning boots, shoes, and other articles.—E. O. W. Whitehouse and E. H. Thomson. Registering the number of passengers carried in and on omnibuses and other public vehicles.—M. Burke. Roller skates.—E. B. Ellington. Capstans worked by water or other fluid pressure.—H. F. Snow. Braces or suspenders.—J. Dean. Construction of carding engines.—H. B. Fox. Cooling and purifying aërated beverage.—A. Beldam. Packing for the stuffing boxes of steam engines and pumps, and for other joints requiring to be made steam, air, or watertight.—H. J. Haddan. Steam boilers (com.)—A. H. Robinson. Roller skates.—W. R. Lake. Air pistols and guns (com.)—O. Wollenberg. Lamps.—J. B. Johnston. Checks, money orders, and bank notes. (Complete specification.)—A. M. Clark. Beer taps (com.)—A. M. Clark. Machine for polishing buttons (com.) (Complete specification.)

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